Technical Study 2

FINANCIAL CONSIDERATIONS FOR PROVIDING INCENTIVES FOR PRIVATE INDUSTRY AND THEIR IMPLICATIONS FOR EMPLOYMENT LEVEL AND STABILITY

L.D. Booth and M.J. Gordon

July 1981

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ABSTRACT

FINANCIAL CONSIDERATIONS FOR PROVIDING INCENTIVES FOR PRIVATE INDUSTRY: THEIR IMPLICATIONS FOR EMPLOYMENT LEVEL AND STABILITY

L.D. Booth and M.J. Gordon

Ordinarily investment decisions in the private sector are privately financed, and government intervention is limited to monetary, fiscal and other policies which influence the general level of investment. However, there are situations in which (1) the private sector would not undertake a particular investment or class of investments without special inducements or subsidies and (2) the employment, growth or other social benefits do not exceed the social cost by an amount greater than the inducement that may be needed to tip the scales for the private decision.

The above types of investments pose two problems: (1) What incentive must the government provide to secure investment by a firm? and (2) Does the social cost-benefit analysis justify the inducement? This report is not concerned with the latter problem. It is concerned with the minimum level and the optimal form of the incentive to be provided, given that the investment is socially desirable. The form of the incentive is important because it will influence both the cost to the government and the likelihood that the firm will conduct its affairs so as to realize the expected social benefits.

To negotiate the incentive effectively, government must be able to evaluate critically the information that firms provide. Briefly, a firm under ordinary circumstances decides whether or not to undertake an investment by determining its net present value--the excess of the project's future cash flows discounted at the firm's cost of

capital over the project's cost. A critical problem here is the value assigned to the firm's cost of capital. The last 30 years have seen important progress in recognizing the role of uncertainty, aversion to risk and capital structure in determining a firm's cost of capital, and a major purpose of this study is to bring together this knowledge in a form that is useful in dealing with our problem.

Chapter II presents the general theory of the cost of capital and capital structure. Chapters III and IV describe and evaluate the discounted cash flow (DCF) and the capital asset pricing model (CAPM) methods for estimating the cost of equity capital. Chapter V illustrates the use of both methods by employing them to estimate the cost of equity capital for a specific company.

Chapters VI and VII apply the above theory to projects that are economically unacceptable and to projects that are financially unacceptable to a firm. Economically unacceptable projects have a negative net present value, and the relative merits of various types of financial incentives (including cash grants, low-cost loans and operating subsidies) are examined. A project may be financially unacceptable because the circumstances of the firm make it unable or unwilling to assume the risk or other costs of financing the project. The various ways in which the private capital markets succeed or fail in dealing with this problem are discussed. Government intervention is required when capital markets fail, and the comparative merits of alternative instruments of government intervention are examined. A special and important case of financially unacceptable projects, discussed in Chapter VII, is the continuation of a firm that faces banckruptcy. The paper makes clear the desirability of tailoring the form of the incentive to the circumstances that make a project unacceptable to the firm without government support.

Finally, Chapter VIII examines the problem of coincidence between expected and actual employment benefits. It is shown that variation among projects in their technology, i.e., their capital-labour ratio, will influence the average level and the stability of employment provided in opposite directions. On any project the capital-labour ratio is a variable that may be subject to a firm's choice. The interest of the firm and the interest of the government in that choice are discussed, and the influence of the form of the government subsidy on the choice is examined. It is shown how some financing arrangements increase instability of employment and increase the likelihood that the project will be abandoned while others have the opposite effect. Some of the issues here represent mild forms of the "moral hazard" problem, but that problem can be very accute with government subsidies. In general, a contract between X and Y poses a moral hazard for X if the contract leads Y to change his behavior in a way that is damaging to X. The report closes with a general discussion of the subject and its applications to government subsidies.

SOMMAIRE

CONSIDÉRATIONS FINANCIÈRES ENTRANT EN JEU DANS L'OFFRE DE STIMULANTS AU SECTEUR PRIVÉ: LEUR INCIDENCE SUR LE NIVEAU ET LA STABILITÉ DE L'EMPLOI

L.D. Booth et M.J. Gordon

D'habitude, les investissements du secteur privé sont financés par des fonds privés et l'intervention gouvernementale se limite aux politiques monétaires, fiscales et autres qui influent sur le niveau général des investissements. Cependant, il existe des cas où (1) le secteur privé ne ferait pas un investissement particulier ou une série d'investissements sans pouvoir bénéficier de stimulants ou de subsides spéciaux, et (2) les avantages sur le plan de l'emploi, de la croissance et autres, par rapport au coût social, dépassent les stimulants qui pourraient être nécessaires pour amener le secteur privé à investir.

Les types d'investissement susmentionnés posent deux problèmes: (1) quel stimulant le gouvernement doit-il offrir pour amener une entreprise à investir? (2) l'analyse sociale des coûts et avantages justifie-t-elle l'offre d'un stimulant? Le rapport ne s'occupe pas du dernier problème, mais traite du niveau minimum et de la meilleure formule que pourrait prendre le stimulant offert si l'investissement était jugé souhaitable du point de vue de la société. Il est important d'établir le type de stimulant, car il influera à la fois sur les coûts pour le gouvernement et sur la probabilité que l'entreprise conduise ses affaires de manière à concrétiser les avantages sociaux attendus.

Pour s'entendre avec l'entreprise sur le type de stimulant approprié, le gouvernement doit être en mesure de faire une évaluation critique des renseignements que cette dernière lui fournit. En temps ordinaire, une entreprise décide d'investir

en se fondant sur sa valeur actuelle nette, c'est-à-dire sur l'excédent des liquidités futures de l'investissement rajustées selon le taux d'escompte, lié au coût du capital pour l'entreprise par rapport au coût de l'investissement. L'élément critique dans ce cas est la valeur donnée au coût du capital pour l'entreprise. Ces trente dernières années, on a fait des pas de géant en reconnaissant le rôle des impondérables, la répugnance à prendre certains risques et la structure des capitaux quant il s'agit d'établir le coût du capital pour l'entreprise. L'étude vise surtout à fournir une vue d'ensemble de la situation, ce qui permettra de mieux aborder le problème.

On trouvera au chapitre II un aperçu de la théorie générale du coût du capital et de la structure du capital. Les chapitres III et IV fournissent une description et une évaluation de la méthode des flux actualisés et de celle de la fixation des prix de l'actif immobilisé en vue de l'estimation du coût du capital. Le chapitre V illustre le recours aux deux méthodes en les utilisant dans l'estimation du coût du capital-action pour une entreprise déterminée.

Aux chapitres VI et VII, la théorie susmentionnée est appliquée à des projets qui sont économiquement inacceptables et à ceux qui sont financièrement inacceptables pour une entreprise donnée. Les premiers ont une valeur actuelle nette négative. La valeur relative des divers types de stimulants financiers (y compris les subventions en espèces, les prêts à faible taux d'intérêt et les subventions d'exploitation) est étudiée en détail. Un projet pourrait être inacceptable du point de vue financier parce que la situation de l'entreprise ne lui permet pas d'assumer le risque ou les coûts de financement que le projet présente. Les diverses façons qu'ont les marchés de capitaux privés de s'en prendre, pas toujours avec succès, à

ce problème sont exposées. Suit une comparaison des divers instruments d'intervention dont dispose le gouvernement quand il est appelé à prendre la relève des marchés de capitaux privés. Un cas particulièrement spécial et grave de projet financièrement inacceptable qu'expose le chapitre VII est celui de la continuation des activités d'une entreprise au bord de la faillite. L'étude montre clairement qu'il est souhaitable d'adapter le type de stimulant aux conditions qui font qu'un projet est inacceptable pour l'entreprise sans une aide gouvernementale.

En dernier lieu, le chapitre VIII étudie le problème de la corrélation entre les avantages attendus et les avantages réels au titre de l'emploi. On voit que les écarts entre les projets sur le plan de la technologie, c'est-à-dire les ratios capital/main-d'oeuvre, influent sur le niveau moyen et la stabilité de l'emploi, soit positivement, soit négativement. Pour tout projet donné, le ratio capital/main-d'oeuvre est une variable qui peut être tributaire du choix de l'entreprise. L'intérêt de l'entreprise et celui du gouvernement par rapport à ce choix sont discutés, ainsi que l'incidence du type de subvention gouvernementale sur ce choix. On voit comment certaines mesures de financement accroissent l'instabilité de l'emploi et la probabilité que le projet soit abandonné, alors que d'autres ont l'effet contraire. Certaines des questions traitées dans l'étude ne représentent que des manifestations mineures du "risque moral", mais ce risque peut se poser avec beaucoup de gravité lorsqu'il s'agit de subventions gouvernementales. En général, un marché conclu entre X et Y pose un risque moral pour X si Y doit modifier son comportement de façon préjudiciable pour X. L'étude se termine par une discussion générale de la question et de ses applications dans le cas de subventions gouvernementales.

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I. INTRODUCTION

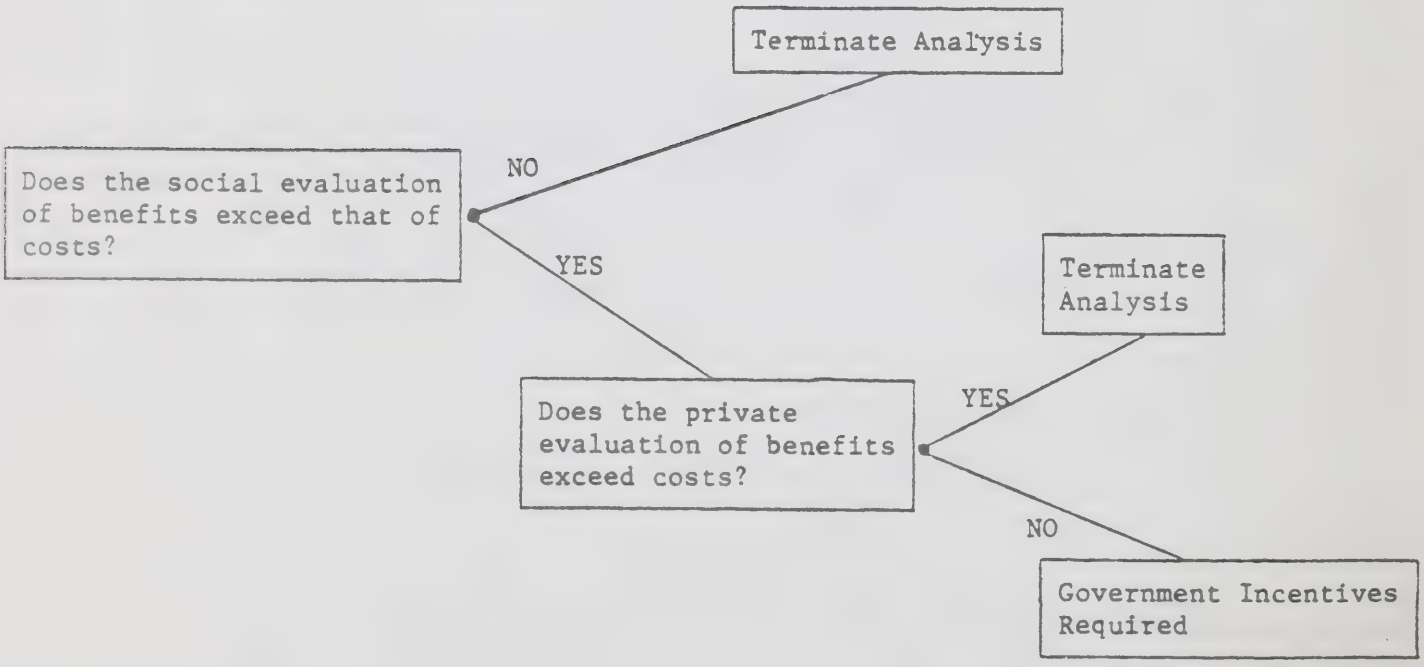
Private investment decisions are based upon a private evaluation of the benefits and costs involved in an investment. However, no investment decison is ever really private, since the implications of that decision, such as for employment, have a bearing on social benefits and costs. Frequently, the social evaluation of an investment differs from the private evaluation of an investment, when this happens it should be the social evaluation which predominates. In this case, either the government can undertake the investment directly or it can indirectly provide incentives to encourage the private evaluation to become consistent with the social evaluation. Because of the well known advantages of private ownership of productive activity, governments in North America have emphasized the achievement of social goals through the private enterprise system. Hence, this report is concerned with how the government can best intervene to achieve this consistency of social and private evaluation of investment.

This report does not stand alone. We assume that the government has previously evaluated the social benefits and costs attached to an investment, a process called cost-benefit analysis. This report is concerned with <u>implementing</u> that decision as efficiently as possible. Schematically, we can say that the first decision made is: does the social evaluation of benefits and costs warrant undertaking this investment? If the answer is yes[1] we have to determine whether or not the private evaluation of the investment is consistent with this social evaluation. If it is, then we terminate the whole process, since there is then no need for government intervention. However, if the private evaluation calls for a <u>rejection</u>

[1] If the answer is no, we assume no action. If the firm decides to undertake the investment, the government could apply all of these incentives in reverse. However, since the government only enters the decision after firm s decide <u>not</u> to accept certain investment projects, this limb of the decision tree is not relevant. In effect we are moving <u>back</u> along the decision tree from private to social analysis and not forward. A forward analysis would require government evaluation of every investment project!

of the investment project, we then have a justification for government intervention, to offer incentives and encourage private acceptance. In this report we are concerned with this latter process, how to structure government intervention as efficiently as possible to achieve social objectives. To do this, we have to understand the private objectives that firms seek to achieve in undertaking investments.

Schematic Representation of Report Coverage



The traditional economic objective of the firm is that of the maximization of profits. However, this provides only an incomplete understanding of the behaviour of the firm in the modern economy. The major weakness of profit maximization is that the firm operates in an uncertain environment. Hence, instead of a single profit figure to maximize, the firm is faced with a range of possible profit levels, the actual one to occur will depend on interest rates, exchange rates, future wage demands, future competition and so on. To maximize even expected profits without allowing for the uncertainty surrounding the possible levels of profit would be incorrect, since this ignores the existence of risk aversion; that individuals will not accept increased uncertainty without adequate compensation by way of increased return. The correct 'extension' of profit maximization to include uncertainty is the concept of value maximization. Firms make decisions on the basis of the value placed by investors on the firm's operations, this value reflects not just the expected level of profits, but also the uncertainty surrounding them.

The concept of value maximization is central to understanding the behaviour of the firm. Firm's finance operations by raising money from equity holders and debt holders. This money is then used to finance the purchase of assets to generate future levels of profit. The firm must ensure that in managing this investment process it increases and does not decrease the value placed by investors on those funds. This value reflects the timing and riskiness of the cash flow stream generated by the firm's assets. Hence, value maximization is considerably more general, and offers a richer interpretation of the behaviour of the firm, than simple profit maximization.

It follows that it is only by understanding the process of value creation that we can understand how the Government can best intervene in the private sector to achieve social objectives. Hence, we begin this report by discussing the central role of a firm's cost of capital in this value maximization process. In section II we show how the cost of capital determines a minimum opportunity cost that the firm must earn on future investments in order for the value of the firm to increase by more than the cost of the funds required for the investment. We also discuss why projects can not be financed with a 100% debt and how the firm's capital structure determines its overall cost of capital.

The key estimate required for determining the cost of capital is an estimate of the investor's required return on his equity investment. The other requirements for estimating the cost of capital, the tax rate, debt ratio and cost of debt are comparatively easy to determine. Hence, in sectionsIII and IV we discuss the two principal models put forward to determine the cost of equity capital, that is the equity investor's required rate of return. In section III we discuss the discounted cash flow (DCF) valuation model that is the accepted method for determining the cost of debt and one of the most widely accepted methods for determining the cost of equity capital. We discuss in detail the Gordon model which is the most convenient way of operationalizing the DCF model in a simple intuitive manner. We discuss in detail the pitfalls in using the Gordon model and show how to use it to obtain a reliable estimate.

In section IV we discuss the capital asset pricing model as the main alternative to the use of the DCF valuation models to estimate the cost of equity capital. Conceptually, these models can both be reconciled in

that the CAPM provides a model for determining the cost of equity capital whereas the DCF model provides a method for estimating it. To motivate our discussion of the CAPM, we first review some empirical evidence as to the structure of market yields on different kinds of securities and the benefits in risk reduction that arise from portfolio diversification. This background enables us to discuss the key concepts of systematic and unsystematic risk on which the CAPM is based. In considering the CAPM, we discuss thoroughly the weaknesses of the model and why if used in a formula manner it can produce very bad estimates of the cost of capital. We finish the section by discussing how the insights of the CAPM enable us to adjust the cost of equity capital across small and large firms because of the different ability to diversify risk.

In section V we provide an exhaustive analysis of an actual company's capital structure and cost of capital. This enables us to go through a step by step estimation procedure to point out the real difficulties in estimating the cost of equity capital and distinguishing between the various forms of financing available to the firm. We further develop an application of the theory to a particular division within the firm to show how divisional costs of capital can be estimated. With the theory developed and applied, we thus provide the framework to evaluate a request for a subsidy, since for a given project we can now determine how unprofitable it is and what is required to encourage the firm to accept it.

In section VI we examine the amount and manner of the government intervention required to persuade a firm to undertake a project with an inadequate private rate of return. Such projects we call economically unacceptable from the viewpoint of the firm. We distinguish them from projects that are economically acceptable and would be undertakne by a firm

under ordinary circumstances but are financially unacceptable or impossible due to the financial condition of the firm that has the project.

A project is financially unacceptable because the firm is unable to obtain debt or equity financing under terms that would be available to a firm with ordinary financial circumstances. Such a project may be represented as having a higher cost of capital than the market place imposes on a firm in a better financial condition. Financial unacceptability also arises because the firm is unwilling to assume the risks associated with the financing available on a project, even though the project and its financing would raise the market value of the firm. Both sources of financial unacceptability are common for small firms. Inability to secure financing arises because small firms are not served well by the financial markets, and unwillingness to secure financing arises because the risk of the firm and the risk of its owners are practically identical. However, both sources of unacceptability may also arise for large publicly traded firms that are owned by portfolio investors who can make their risk independent of the risk of the shares in their portfolios. Section VII examines the amount and manner of government intervention that should be employed in the case of projects that are economically profitable but financially unacceptable.

In both sections VI and VII we consider the types of incentive programs that are available to the government to encourage the firm's acceptance of a project that it would not normally accept. However, encouraging a project's acceptance is not the only concern of government. Governments are also concerned that once undertaken the social objectives that prompted intervention in the first place will continue to be met. In section VIII we consider how employment varies with different types of technologies adopted by the firm

and why the objectives of the firm and of the government are often quite contradictory. We consider how the financial incentive program can be structured to ensure that government social objectives are most likely to be continually met. One tangential problem that arises in government financing of private projects is what is known as the moral hazard problem. This problem is intimately connected with the employment continuity problem and the structing of the financial incentive package. We finish the report with a discussion of how convertible securities can be used to avoid the moral hazard problem and when structured correctly can also help to maintain the continuity of employment benefits.

II. GENERAL THEORY OF THE COST OF CAPITAL

1. The Cost of Capital

Individuals and financial institutions have many alternative investment media available, differentiated by type of issuer e.g. government or private and type of security, e.g. fixed interest debt or equity securities. In this competitive market the firm must be able to offer a competitive rate of return to the investor, otherwise it will not be able to attract new funds and/or the market value of existing funds committed will decline. This competitive rate of return is the opportunity cost to the investor of investing in the firm's securities, rather than in other available financial securities. The concept of a cost of capital is best understood as the overall opportunity cost of an average dollar invested in the firm.

Firm's raise funds from investors through a variety of financial securities, the two chief ones being fixed interest debt securities and ordinary shares of common stock. Each of these two classes of securities will have an opportunity cost or a required rate of return, i.e., a rate of return that the investor must expect to receive, in order to persuade him to hold the security at the prevailing market price. The required rate of return on debt, which we shall call k_d, is easy to calculate. This is because what the investor expects to receive on most debt securities is clearly spelled out in the bond contract, by way of a stated coupon rate and fixed redemption date. Hence, it is a mechanical exercise to determine k_d. It is the rate of return that sets the market value of the debt security equal to the stream of interest and redemption payments received from the security. Moreover, continual new issues of Government and corporate debt securities makes the calculation of the required rate of return on existing and new debt securities extremely accurate. This is not the case with ordinary shares of common stock, where there is no legal right

to receive a dividend and no guarantee of it maintenance or gorwth. However, conceptually the problem is exactly the same, to determine the opportunity cost of the funds invested in the firm's equity securities. This opportunity cost is the required return on common stock and it is called k_e.[1]

We can illustrate the importance of the cost of capital concept with a highly simplified example. Assume that a firm is worth \$100M of which \$60M is the market value of its equity and \$40M the market value of its debt. Assume further that its abbreviated income statement is expected to be,

	\$M
Earnings Before Income and Tax (EBIT)	20
Interest (I)	5
Earnings Before Tax (EBT)	15
Tax (T)	6
Earnings After Tax (EAT)	9

For convenience, we will assume that the firm is a stable firm, so that these figures are perpetuities. That is although actual results may vary from year to year, due to all manner of unforeseen circumstances, the above estimates are the best estimates for every future year.

The interpretation of the above data is that the equity holders require a return of 15% on the \$60M market value of common equity. That is a 15% return on the \$60M market value of equity is consistent with the \$9M that equity holders expect to receive. Similarly, the debt holders require a return of 12.5%, since that return on the \$40M market value of debt is consistent with the expected annual interest payments of \$5M. An alternative way of viewing the data is that given a required return of 15% for equity holders and 12.5% for debt holders the expected annual receipts of \$9M and \$5M are worth \$60M and \$40M respectively. In this sense, given the security holder's required return the earnings estimates 'support' the current market values.

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[1] In sections III and IV we spend some time developing alternative estimation procedures for k_e.

This example shows how the market value of the firm's debt and equity securities together with the market determined required rates of return, determine the necessary expected profitability of the firm. If for example, due to increased foreign competition, the firm's prospects deteriorated, so that its EBIT decline to $16M, the earnings to the common stockholders would decline to $6.6M. Common stockholders would still require a 15% rate of return, since that is the rate of return that could be earned on a security of similar risk elsewhere. Hence, the existing common stockholders would find that the common stock could only be sold for $42.5M. Thus the market value of the common stock and the total firm value declines by $17.5M. Conversely, if the firm's EBIT was expected to increase to $24M, then the expected earnings to common stockholders would increase to $11.4M and the market value of the common stock would increase to $76M. It is this sensitivity of common stock prices to changes in profit expectations that is a major factor in the increased risk to the investor of holding shares of common stock. Corresponding to this increased risk is the higher assumed required rate of return of 15% on the investment in common equity securities.

In examining the simplified expected income statement above, we note that the firm must be expected to earn $20M in EBIT to support the $100M market value of its combined debt and equity securities. This represents a 20% pre-tax and a 12% after-tax required rate of return on long-term capital. Since, in evaluating investments the comparison is normally done on an after-tax basis, it is this after-tax required rate of return that is most relevant. This after-tax required rate of return on long term capital is more commonly known as the firm's after-tax weighted average cost of capital or more simply its cost of capital (k_A). It is conveniently calculated as,

$$k_A = k_e \frac{S}{V} + k_d (1-t) \frac{D}{V} \qquad (1)$$

where S, D and V are the market values of common stock, debt and the total firm respectively (V=S+D) and t is the corporate tax rate.

We have shown that the cost of capital is determined by the required rates of return on its debt and equity securities, we will now show how this cost of capital enters into the firm's decision as to whether or not to undertake an investment. Suppose the firm can find a $10M project that has the same risk as its existing investments and is expected to earn after-tax 10% per year. That is 2.5% more than the after-tax cost of debt of 7.5%. The result of accepting this project would be the following expected income statement,

	Original	Project	Total
EBIT	20	1.67	21.67
T	5	0.5	5.5
EBT	15	1.17	16.17
T	6	0.47	6.47
EAT	9	0.70	9.7

where we have assumed that the new project like the firm's existing investments would be financed 40% debt and 60% equity.

After accepting the project we note that the firm's earnings after-tax to common stockholders increases by $0.7M to $9.7M. This new earnings stream increases the market value of the firm's common stock from $60M to $64.67M, and the overall value of the firm to $108.67M from $100M. However, to finance this project $10M in new funds has had to be raised; $6M in new equity and $4M in new debt. Thus, the value of the firm should have increased to at least $110M and the value of the common stock to a least $66M, that is

the original market values plus the amount of new funds raised. In other words, in accepting this project the firm has caused the market value of the total amount of capital i.e. original plus newly comitted to decrease.

The reason for the loss in value is that the 10% expected rate of return is less then the firm's cost of capital of 12.0%. The firm's investors could expect to earn an averageof 12.0% elsewhere. Hence, when the firm raises money to invest at an expected rate of return that is less than this opportunity cost, the market value of the firm will decline until it reaches a value that allows new investors to earn this expected rate of return.[1] In other words, the cost of capital of 12.0% is the expected rate of return on new investment that will at least leave the market value of the firm unchanged. In evaluating new investment the management of the firm will only accept projects that are expected to earn a rate of return in excess of the firm's cost of capital. To do otherwise would be to knowingly cause a decline in the value of the stockholder's investment in the firm, a course of action that is contrary to the interests of the 'owners' of the firm.

This representation of the valuation and investment process is conducted in terms of nominal rates of return, that is rates inclusive of changes in purchasing power and rates that are actually expected to be received. This is the form of analysis of all private sector decision making. However, the analysis can be couched in terms of real rates of return and thus be compatible with public sector practices. For the cost of capital we 'simply' deflate by the geometric average of one plus the future expected rates of inflation. For the investment returns, we then deflate each inflow by the geometric average of the annual rates of inflation up to that date. We then simply compare the real cost of capital with the real expected rate of return.

[1]The value of the old and new debt will be $40M and $4M respectively. The new shareholders will insist on receiving shares worth $6M if they know the expected profitability of the new project. Hence, the old shareholders will suffer a decline in the value of their stock of $1.33M.

The practice in private corporations of analyzing investment in terms of nominal rates of return is justified because most private contracts stipulate that performance will be in nominal terms. Moreover, accounting and tax regulations and conventions are also determined in nominal terms. Hence, in evaluating investments the firm forecasts nominal revenues, variable costs, depreciation and cost of goods sold to determine the nominal after-tax cash flow. This amount is sensitive to inflationary expectations, since the depreciation is in constant nominal dollars and the cost of goods sold rarely immediately adjusts for inflation. Hence, changes in inflationary expectations change the value of the nominal cash flows, since the real tax burden varies with inflation due to the existence of fixed nominal expenses.[1]

Similarly, although it is conceptually correct to deflate nominal required rates of return by the expected rates of inflation, in practice this causes many problems. One problem is that inflationary expectations vary for future years, thus the adjustment to be made to the cost of five year bond is not the same as for a one year promissory note. Unless the analyst is prepared to accept a constant real term structure of interest rates, it becomes an amazingly complicated procedure to determine the real cost of a firm's composite debt securities. Moreover, the firm is able to deduct all the nominal interest payments for tax purposes rather, then the real interest payments. Hence, the real after tax cost of debt is often negative during a period of high inflationary expectations.[2] This makes the real cost of capital

[1]See S. Davidson and R. Weil, "Inflation Accounting: What Will General Price Level Adjusted Income Statements Show," Financial Analysts Journal (January/February 1975) for a discussion of the effects of inflation.

[2]As remarked earlier, during these periods, the firm's tax burden is also higher. Hence, the effect on investment and the value of the firm is ambiguous. See F. Modigliani and R. Cohn, "Inflation Rational Valuation and the Market," Financial Analysts Journal (March/April, 1979).

very sensitive to the expected rate of inflation. Moreoever, as the cost of capital is reduced, it also makes the estimate of the project's net present value very sensitive to the expected rate of inflation. Hence, although we can conceptually use real expected rates of return and a real cost of capital, the estimates are subject to more error than usual and the errors compound themselves in producing a net present value estimate that is most often unreliable. Unlike the government, private corporations in their evaluation of investment are not insensitive to future expected rates of inflation.

Finally, it should be noted that joining a social cost-benefit analysis in real terms and a private net-present-value analysis in nominal terms poses no problems whatsoever. Assume that the two analyses are carried out in 19XX. The social cost-benefit analysis expresses the costs and benefits in all subsequent years in 19XX dollars and arrives at a net benefit in 19XX dollars. The private analysis is conducted with nominal values for the future cash flows and a nominal discount rate. However, the end result is a subsidy in 19XX dollars that is required to persuade the firm to undertake theinvestment. The social net benefit in 19XX dollars and the private subsidy in 19XX dollars are directly comparable.

The above presumes, of course, that the social net benefit has been reduced to 19XX dollars. Typically the social benefit consists of an increase in the level and quality of employment over some future time period. The social cost-benefit analysis converts this increased employment to its present value in 19XX dollars. Assigning a dollar value to the increase in the level and quality of future employment due to a project is no less, perhaps an even more formidable task than estimating the increase.

2. Capital Structure

It might be thought that one easy way of getting the firm to accept the project discussed in section II.1. would be to encourage 100% debt financing of the project. If this happened the expected income statement would become,

	Original	Project	Total
EBIT	20	1.67	21.67
T	5	1.25	6.25
EBT	15	.42	15.42
T	6	0.17	6.17
EAT	9	0.25	9.25

If we use the same 15% required rate of return for the common equity holder, the market value for the common stock would increase to $61.67M and the overall value of the firm to $111.67M. Since these values exceed the original market values plus the cost of the project, it might be inferred that the project becomes profitable under 100% debt financing.

The problem with this line of reasoning is that no project can be financed with 100% debt because some one has to bear the risk of project failure. In the previous example, the firm could quite conceivably raise $10M in debt to finance the project. However, the lender would only provide the money, providin that access to the firm's existing assets is insured should the project

get into financial difficulties. In other words, the existing assets of the firm are serving as collateral for the $10M loan. In this case, the existing stream of earnings to the common stockholders has become riskier, since the equity interest is required to support the borrowing to finance the existing assets plus the 100% borrowing to finance the new project. This increase in risk will cause the stockholders' required rate of return to increase above 15%. That is, the opportunity cost for the equity investment is now higher, since it is comparable to a higher risk investment, that offers a higher rate of return. Moreover, an increase in the required rate of return on common stock to just 16% would cause the overall market value of the common stock to decline to $57.8M and the value of the firm to decline to $107.8M.

The problem of the optimal amount of debt financing, that is, the optimal capital structure of the firm and the optimal debt capacity of an individual project, is central to financial theory. Franco Modigliani and Merton Miller[1] have shown that if financial markets are perfect and there are no corporate or personal taxes, then the firm's debt financing decision does not affect the value of the firm. In other words, varying the proportion of debt and equity in a firm's capital structure when financing a project leaves the weighted average cost of capital unchanged. Their argument is simply that in a perfect financial market the actions of the firm in structuring its debt decision can be completely undone by an investor borrowing on margin, or purchasing both the firm's debt and the firm's equity securities. This 'homemade leverage' theorem causes the investor's required return on equity to increase with

[1] F. Modigliani and M. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," American Economic Review, (June 1958).

financial leverage by an amount that is sufficient to exactly offset any increase in expected earnings. Thus, the amount of debt financing will have no effect on the value of the firm and no effect on the firm's cost of capital.

However, financial markets are not perfect and corporate and personal taxes do exist. Modigliani and Miller[1] have shown that the tax deductibility of interest payments creates a tax shield that causes the value of the firm to increase with corporate leverage. The corollary of this is that the firm's cost of capital will decrease with the proportion of debt financing. However, Arditti, Levy and Sarnat[2] have shown that the personal income tax reduces the tax benefit of corporate debt, due to a lower effective tax rate on common stock earnings and the tax deductibility of personal interest payments at the marginal rate when the debt is used to finance personal investments. Moreover, DeAngelo and Masulis[3] have pointed out that many firms, due to accelerated depreciation allowances and other government investment incentives, do not pay tax at the full corporate tax rate, which further reduces the value of the corporate tax shield on debt and any potential reduction in the corporation's cost of capital.

The above theory on the relation between a corporation's leverage rate and its cost of capital is based on the assumption that capital markets are perfectly competitive apart from taxes. However, financialy markets are not perfect in the economist's true sense of the word, and a general solution to the optimal capital structure problem in actual financial markets has still

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[1] F. Modigliani and M. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction", American Economic Review, (June 1963).

[2] F. Arditti, H. Levy and M. Sarnat, "Taxes, Capital Structure and the Cost of Capital: Some Extensions", Quarterly Review of Economics and Business (Spring 1977).

[3] M. DeAngelo and R. Masulis, "Optimal Capital Structure Under Corporate and Personal Taxation", Journal of Financial Economics, 8 (1980).

not been derived. A most obvious imperfection is that corporations can usually borrow at a lower effective cost and on more advantageous terms than private individuals.[1] This is primarily due to the lower proportional transactions costs faced by the corporation and its legal status, offering more secure collateral for a long term loan. Its effect is to make corporate borrowing more advantageous than person borrowing to achieve the effects of financial leverage. On the other hand, as a corporation's debt ratio rises beyond some point, a number of factors come into play which make its further increase more costly and less attractive. One such factor is the increased probability of bankruptcy and its attendant costs. Another factor is the unwillingness of financial institutions to make loans on which there is a material risk of default.

The result is that an optimal capital structure for the firm and an optimal debt capacity for a project does exist.[2] We can illustrate this by means of the graph in figure 1. For an initial increase in the amount of debt financing, the net tax advantage and the lower effective interest rates faced by the corporation cause the overall cost of capital to decline. However, with the increase in debt the firm becomes riskier, because of the increased fixed financial changes for interest and sinking fund payments. Hence, private investors become unwilling to lend money at the previously advantageous terms because of the increased chance of financial distress and/or bankruptcy. The result is that individual private investors demand ever higher interest rates to compensate for the increased risk. Moreover, the largest suppliers of debt capital, the financial institutions cease

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[1] M.J. Gordon and C. Kwan, "Debt Maturity Default Risk and Capital Structure", Journal of Banking and Finance, 3 (1979).

[2] M. Ferri and W. Jones, "Determinants of Financial Structure: A New Methodological Approach", Journal of Finance, (June 1979).

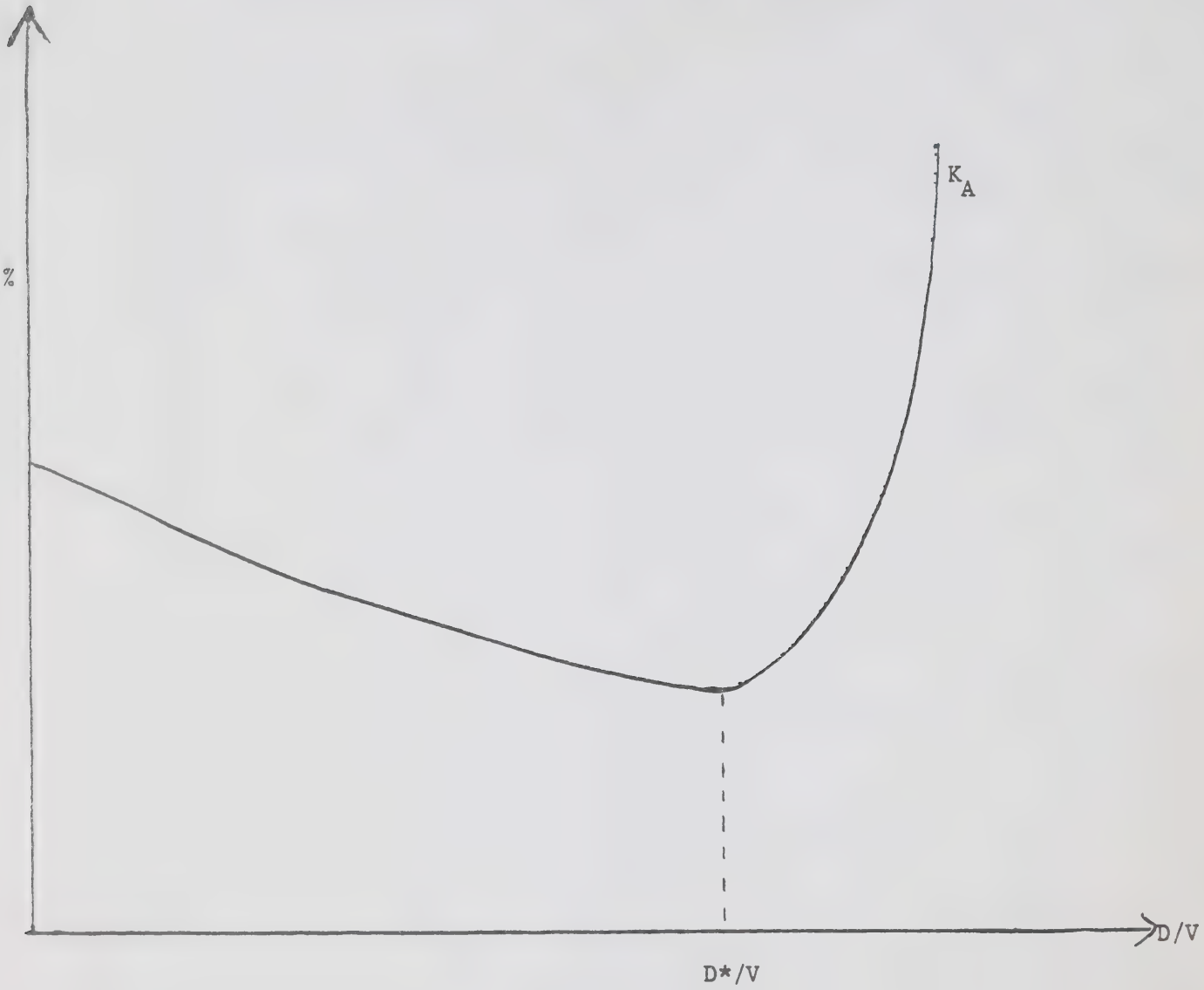
lending entirely. The effect is that past some minimal cost of capital the schedule starts to increase drastically and then become vertical, since a firm is unable to borrow money regardless of the interest rate, when its debt ratio passes some level.

The cost of capital schedule in figure 1 determines an optimal capital structure for a normal firm. The firm will determine its optimal capital structure by assessing its ability to support the fixed interest charges and sinking fund payments stated in the bond contract. Donaldson[1] has shown that this debt capacity is most effectively determined by a full cash flow analysis under different recession and industry conditions. However, the firm still has to convince the lending institution of the security of the loan, despite an in house cash flow analysis that suggests that the firm can support more debt. The lending institution will be more concerned with traditional financial analysis using ratios such as the times interest earned and coverage ratios. For example, with the 100% debt financing of the project on p. 11, the times interest earned ratio declines from 4.0x to 3.46x. Hence, the lending institution will feel that the $50M worth of debt after the project financing is not as safe as the $40M of debt before the project financing. The result will be that the financial institution will either require a higher interest rate on the loan, stiffer contract provisions on the firm's financial structure, or will refuse to 100% finance the new project. Moreover, since the new debt makes all of the existing debt more risky, these original debt holders will have previously secured contract provisions offering them compensation for extra corporate borrowing. The result is that 100% debt financing at the existing interest cost may not be feasible and the project

[1] G. Donaldson, "New Framework for Corporate Debt Policy", Harvard Business Review, (March-April 1971).

FIGURE 1

Optimal Capital Structure and The Cost of Capital



may have to be financed 60% with new equity and 40% with new debt to avoid violating bond contract provisions and to gain the necessary funds.[1]

In our hypothetical example, we can see that if the firm determines a 40/60, debt equity ratio to be optimal, then the firm can not finance a new project with 100% debt. In practice, the firm is continually interacting with the financial markets, issuing debt one year and equity another year, to maintain its optimal capital structure. This interaction will also include a continuous flow of information to allow institutions to correctly assess the risk of lending to the firm, a process which establishes the firm's bond ratings. However, the cost of capital schedule beyond the optimal range is not as determinate as that before it. This is because no firm plans to operate in this range, nor is able to except for unforeseen circumstances.

To clarify this point, we can see that Massey-Ferguson for example is most definitely in the range beyond the optimal capital structure. Any firm whose bonds have a yield to maturity in the 25-45% range is not minimizing its cost of capital![2] However, Massey did not plan to be in that range, it occurred as a result of inadequate financial planning, bad management, and bad luck. However, once in that range, many investors become locked in as it becomes impossible to resell the debt securities at anywhere near face value. Hence, the cost of capital becomes extremely difficult to determine as objective market values are not available. In a situation like this, the firm is in effect unable to access the capital markets without government intervention. However, from the point of view of determining an optimal

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[1] See A. Chen and E.H. Kim, "Theories of Corporate Debt Policy," Journal of Finance (May 1979) for a recent review of the capital structure problem.

[2] This is the range of yields on Massey's short and medium term U.S. eurodollar loans as at year end.

capital structure, the intention of avoiding a 'Massey' financial situation is sufficient to limit the firm's choice of a debt-equity ratio and determine an optimal capital structure.

III. DISCOUNTED CASH FLOW (DCF) MEASUREMENT OF THE COST OF CAPITAL

1. Stock Value Model

In section II.1. we discussed the importance of the cost of capital concept for valuation purposes and how it is used to evaluate new investments. We assumed a highly simplified situation where the required rate of return was equal to the expected earnings yield. That is for common stock the required rate of return was equal to the expected earnings to common stockholders divided by the market value of the common stock. In practice, this simple perpetuity model is rarely appropriate for determining the required return on equity and more robust models are required. In sections III and IV we develop the discounted cash flow and capital asset pricing models as alternative methods of determining the cost of equity capital.

The discounted cash flow (DCF) approach calculates the internal rate of return that sets the present value of the expected future cash flows equal to the market price of the security. This internal rate of return is the compounded annual rate of return the investor expects to receive by paying the market price for the security, i.e., it is the market required rate of return. The emphasis in DCF models is on observing market prices and expectations of future cash flows to directly estimate the required rate of return. An alternative approach is to examine the determinants of the required rate of return and the market price. We know from the behaviour of individuals subject to uncertainty,[1] that the higher the amount of uncertainty, the higher the 'risk premium' they require for being in an uncertain situation. Hence, risk-adjustment models, such as the variations of the capital asset pricing model (CAPM), seek to estimate the amount of risk in a financial security and from there what the required rate of return must be.

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[1] M.J. Gordon, G. Paradis, and C. Rorke, "Experimental Evaluation of Alternative Portfolio Decision Rules," American Economic Review, (March 1972).

It is important to realize that the DCF and CAPM estimates of the required rate of return are entirely consistent in their theoretical derivation. The CAPM provides a trade-off between risk and return and an estimate of what the equilibrium required rate of return on the security must be. This rate of return can be calculated by observing the market price and the expected future cash flows and using the DCF formula to measure the required rate of return implicit in those observations. That the CAPM and DCF estimates are often sharply in disagreement is a reflection of the different assumptions underlying their derivation and the fact that the approaches are often used by inexperienced analysts unfamiliar with the weaknesses and strengths of the two models. It is the intention of sections III and IV to develop both approaches, so that some of the inevitable pitfalls in the use of the CAPM and DCF models can be avoided. The worked example in section V will reinforce the ideas and show just where judgement and experience is required in order to calculate an accurate estimate for the firm's cost of capital.

The discounted cash flow model can be used initially to determine the required rate of return on the corporation's debt, since this is a very accurate estimate. We use the basic formula for bond valuation,[1]

$$V_B = \frac{rB}{(1+k_d)} + \frac{rB}{(1+k_d)^2} + \frac{rB}{(1+k_d)^3} \cdots\cdots \frac{rB+B}{(1+k_d)^N} . \qquad (2)$$

We know from the indenture provisions in the bond contract what the stated coupon rate of interest (r) is, what the par value of the bond is (B, which is almost always $1,000) and what the redemption date is (N). Since we observe the market price V_B, it is a simple matter of trial and error to

[1] See any basic finance text such as J.F. Weston and E. Brigham, Managerial Finance, (6th edition), Dryden Press, 1978.

calculate what the internal rate of return or required rate of return must be to set market value equal to the present value of the expected cash flows.[1] Hence, the required rate of return on debt is an almost trivial calculation. Even for debt issues that are not publicly traded, risk assesments by bond rating services such as Moody's and new traded issues of debt with similar features make any estimate exceedingly accurate.

For equity securities the principles underlying the determination of the required rate of return are identical. The problem is that the expected cash flows are not amenable to objective calculation, since there is no legal right to dividends and no certainty as to their maintenance or growth. However, there are expectations as to what the future dividends will be and relatively simple and reliable methods for calculating the resulting required rate of recurn. Conceptually, the valuation formula for common stocks is just,

$$P_0 = \frac{D_1}{(1+k_e)} + \frac{D_2}{(1+k_e)^2} + \frac{D_3}{(1+k_e)^4} \cdots\cdots \frac{D_\infty}{(1+k_e)^\infty}, \qquad (3)$$

where D represents the expected dividend per share subscripted for the year in which the dividend is expected to be received. There is no redemption date for common stock, thus the stream of dividends is expected to continue for the life of the equity security, which is infinity.

The valuation equation for common stock can be enormously simplified by assuming that dividends are expected to grow at some compounded average annual rate (g). In which case (3), reduces to the well-known Gordon growth model[2]

$$P_0 = \frac{D_1}{k_e - g} \qquad (4)$$

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[1] For bonds this required rate of return is more commonly known as the yield to maturity.

[2] A fuller statement of the theory is found in M.J. Gordon, The Investment, Financing and Valuation of the Corporation, Homewood, Ill., R.D. Irwin, 1962.

Solving equation (2) for k_e results in an expression for the investor's required rate of return

$$k_e = \frac{D_1}{P_0} + g \tag{5}$$

In other words, to measure the expected return that investors require, we may take the sum of the dividend yield and the expected rate of growth in the dividend.

An alternative approach to Equation (3) for the price of a share is:

$$P_0 = \frac{D_1 + P_1}{1+k_e}. \tag{6}$$

Here, the current share price is just the present value of next period's dividend and the end-of-period price. However, if dividends are expected to grow at the constant rate g, then ceteris paribus the share price should also grow at g. Hence, we have $P_1 = P_0 (1+g)$, and this substitution plus a little algebra results in Equation (2). Hence, the two approaches to share valuation result in the same measurement equation for the required rate of return. In order to use Equation (5), we need to measure both the dividend yield and the expected rate of growth in the dividend.

2. Measurement of Dividend Yield

The term for the dividend yield in equation (5) is the expected dividend for the coming period, D_1, divided by the current price, P_0. The value assigned to P_0 should be the price of the share at the time the required return is being estimated. The reason for using the current price is that at each point in time it reflects all the information available to a company's

investors concerning future dividends. Hence, the yield investors require on any date is the discount rate that equates, on that date, the current price and the expected stream of future dividends. To use an average of share prices over some prior time period for P_0 would result in a value for k_e without meaning, that is, it would not provide the average value for k over the prior time period. Furthermore, to obtain an average value for k over some prior time period, one must average the values of share yield -- not of share price.

D_1 is the forecast dividend for the coming year if dividends are paid annually. Common practice, however, is to pay dividends quarterly, in which case D_t in Eq. (3), the fundamental expression for share price, is a quarterly dividend. However, because it is customary and convenient to think in terms of annual and not quarterly figures for rate of return and growth statistics, annualized figures will be used here. Annualized figures are simply four times quarterly figures. That is, if the current price of a share is P_0=\$50.00, and if its forecast dividend for the coming quarter is D_1=\$1.25, the quarterly dividend yield is \$1.25/\$50.00=2.5%, and the annualized dividend yield is 10%.

3. Measurement of Expected Growth

The difficult problem is the determination of the long-run dividend growth expectations of investors. To solve this problem, it is essential to understand the determinants of long-run, expected dividend growth. If a company is expected to earn a rate of return of r on its common equity, and if it retains the fraction b of its earnings, then each year its earnings per share can be expected to increase by the fraction br of its earnings per share in the previous year. Thus, br is an excellent measure of the

expected rate of growth in future earnings per share. If the company is expected to have a stable retention ratio and, therefore, a stable dividend payout ratio, it follows that br is also an excellent measure of the expected rate of growth in future dividends per share. That is:

$$g = br. \tag{5}$$

This relationship is illustrated in Table III-1. There the hypothetical initial common equity, or book value, per share = $10.00, r = .10 and b = .4. The first period earnings are expected to be $1.00 per share and the expected dividend is $.60. The retained earnings raise the book value of equity to $10.40 at the start of the second year, and r times that is $1.04, which is equal to the earnings per share for the second year. The dividend in the second year is expected to be $.624, and so on through time. The earnings, dividends, and stock price are expected to grow at the rate br = (.4)(.10) = .04 in every future year.

If investors require an 8% return on the stock, the initial price is:

$$P_0 = \frac{D_1}{k-g} = \frac{\$.60}{.08-.04} = \$15.00. \tag{7}$$

Similarly, the expected share price after one year is:

$$P_1 = \frac{D_2}{k-g} = \frac{\$.624}{.08-.04} = \$15.60. \tag{8}$$

The price in subsequent periods rises by 4% as long as the yield investors require on the share remains equal to 8%.

Obviously, a firm's actual return and retention rates are not constant over time, since the firm's earnings are affected by all manner of unforeseen circumstances. However, if investors expect that a company will on

TABLE III-1

Relationship Among a Company's Retention Rate,
Rate of Return, Rate of Growth in Dividends, and Market Price

Year	SOY Book Value[1]	Share Earnings[2]	Share Dividends[3]	Retained Earnings[4]	Price[5]
1	$10.00	$1.00	$.60	$.40	$15.00
2	10.40	1.04	.624	.416	15.60
3	10.816	1.082	.649	.433	16.22
4	11.249	1.125	.675	.450	16.87
5	11.699	1.170	.702	.468	17.55
6	12.167	1.217	.730	.487	18.25

[1]For year two on, the previous value plus retained earnings in previous year.

[2]10% of start-of-year book value based on r = .10.

[3]60% of share earnings based on b = .4.

[4]Earnings less dividends.

[5]Based on P = D/(k-g), where D = the dividend for the year, and where in every period k = .08 and g = .04.

average earn a rate of return r and retain the fraction b of its earnings, they will expect the dividends, earnings, and price to grow at a rate br due to retention of earnings.

It might be thought that past rates of growth in either earnings, dividends, or prices could be used as estimates of the forecast rate of future growth in dividends. However, these past rates of growth are most unreliable due to extraneous influences on them, such as changes in the rate of return on common equity, changes in the retention rate, or changes in the yield required by investors in the case of price changes. The potential error in using past growth in earnings to estimate g is illustrated in Table III-2, where the hypothetical company's return on common equity is 10% in the first three periods and 15% in the last three periods. With a retention rate of 40% and a return on common of 15%, the growth rate is 6% in the last three years. This is a reasonable estimate of the expected future growth rate as of the end of the sixth year. However, with the 56% growth rate due to the increase in the return on common in the fourth year, a simple average of the five annual past growth rates in earnings is in excess of 15%. Clearly, this type of estimate of future growth rates cannot be used with any reliability at all.

It can also be demonstrated that a change in the dividend payout rate makes the past rate of growth in dividends an incorrect basis for predicting g. Assume that a company has been earning a rate of return on its common stock of $r = .10$, that it has been retaining the fraction $b = .60$ of its earnings, and that, as a consequence, its dividend has been growing at the rate $br = (.60)(.10) = .06$. If the company were to raise the fraction of earnings it pays in dividends so that b falls to .25, the rate of growth

TABLE III-2

Influence of Change in Rate of Return
On Rate of Growth In Earnings

Year	SOY Book Value[1]	Share Earnings[2]	Share Dividends[3]	Retained Earnings[4]	Growth Rate of Earnings
1	$10.00	$1.00	$ .60	$.40	
2	10.40	1.04	.624	.416	.04
3	10.816	1.082	.649	.433	.04
4	11.249	1.687	1.012	.675	.56
5	11.924	1.789	1.073	.716	.06
6	12.640	1.896	1.138	.758	.06

[1]Value for previous year plus retained earnings in previous year.

[2]10% of book value in first three years, and 15% of book value in last three years.

[3]60% of earnings.

[4]50% of earnings.

in the dividend would then fall to br = (.25)(.10) = .025. However, over the period that spans the rise in the dividend payout rate, the dividend would have grown at an even higher rate than the prior 6%. It would only be correct to project the past rate of growth in the dividend into the future on the highly implausible assumption that the company is expected periodically to raise its payout rate.

The conclusion is thus that past growth rates in dividends and earnings are of only limited use in predicting the future growth rate in dividends. Moreover, the best estimate of g obtained from a company's current values of b and r or from weighted averages of recent values is only appropriate if there is no additional information available that can be used to forecast their future values. In most cases an analysis of recent annual reports and statements of management, together with an assessment of industry conditions, is sufficient to refine the estimate for the expected rate of return. With this expected rate of return the resultant growth estimate for dividends along with the dividend yield provides an excellent estimate of the required return on equity capital. Moreover, this estimate is then completely consistent with the valuation methods used to determine the required returns on debt and preferred stock capital.

The usefulness of the discounted cash flow (DCF) model depends on the suitability of past data for predicting future dividends. In some cases for example where a firm pays no dividends at present with no history of dividend payments, the problem is acute. In this particular case, the model requires a prediction of the date when dividends will be paid and the future dividend growth expectations on that date.[1] Hence, although the model can

[1] See B. Malkiel, "The Debt-Equity Combination of the Firm and the Cost of Capital: An Introductory Analysis", General Learnings Press, 1971.

cope with all possible circumstances it is particularly difficult to implement when financial policies are erratic and highly uncertain.

IV. CAPITAL ASSET PRICING MODEL (CAPM) MEASUREMENT OF THE COST OF CAPITAL

1. Variations in Yields Among Securities

The alternative approach to estimating the required return on equity securities is based upon the historical relationship between yields on different securities. With corporate securities, the hierarchy of claims to corporate resources in the event of liquidation and the priority of claims on the firm's income stream mean that equity as the residual ownership claim is regarded as a more risky security then preferred stock or debt. Hence, in normal circumstances, the required return on equity would be higher than that on preferred stock, which in turn would be higher than that on corporate debt. Similarly the required return on corporate debt would be higher than that on provincial or federal government securities, since the latter do not subject the investor to any significant risk of default.[1]

This historical structure of market yields is based on the underlying risk attached to each security. Hence, in this section we will examine models that determine the investor's required rate of return directly from an assessment of the amount of risk involved. First, however we should note that the DCF model does measure the impact of risk. For example in our previous example, we calculated an 8% required rate of return determined by a 4% expected growth rate and a 60¢ dividend on a $15 share price. If the amount of risk increased, for example because of some uncertainty about possible future foreign competition, the stock price would fall to say $12, even though the expected dividends are unchanged; that is we are just less certain of receiving those expected dividends. In this case, using the DCF model we would now have a 5% dividend yield, i.e., 60¢ on $12, and a 4% expected growth rate giving a 9% required rate of return. The increased risk has caused the required rate of return to increase, which we have measured by the DCF formula.

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[1] This ignores any deliberate alteration in the structure of market yields, or required rates of return, brought about by taxation differences.

The problem is, what is the risk that is relevant to holding financial securities that causes their required rates of return to change? One answer often given is the variability in the holding-period return on the security. The holding-period return (HPR) is the dividend plus the change in price of the security over the period divided by the price at the start of the period. Hence, the standard deviation of the rate of return on a security, defined as its HPR is one of the basic risk measures used in measuring the risk in holding financial securities. Ibbotson and Singuefield[1] calculated the following data on the arithmetic mean rate of return on various securities between 1926 and 1978,

	Arithmetic Mean	Standard Deviation
Common Stocks	11.2%	22.2%
Long-Term Corporate Bonds	4.1%	5.7%
Treasury Bills	2.5%	2.2%
Consumer Price Index	2.6%	4.8%

The mean rate of return is the average of the one year rates of return between 1926 and 1978. The implication of the data is that on average, the most profitable investments were (in descending order) common stocks, corporate bonds, long-term Government bonds and treasury bills. Note that after we account for inflation the return on treasury bills basically just maintained the purchasing power of the investment. However, these higher rates of return did not come about by accident, since over the 52 year period the most uncertain investments i.e., those with the most variation in their annual rates of return were (in descending order) common stocks, corporate bonds, long-term government bonds, and then treasury bills. Hence, our basic intuition is borne out by the historical performance of the securities, the more variable the annual rate of return the higher the annual rate of return required for investing in the security.

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[1] "Stocks, Bonds, Bills and Inflation: Updates," Financial Analysts Journal, (July-August, 1979).

2. Systematic Versus Unsystematic Risk

The Ibbotson and Singuefield data explains the differences in the required rates of return between different classes of securities. However, in looking at the standard deviation of the annual rates of return, they ignored one important part of 'investment behaviour'. That is that investors do not generally hold an individual security in isolation; instead they hold portfolios of securities. This fact of investment life, that investors generally do not put all 'their eggs in one basket', has important implications for what we mean by risk, since the risk of holding a security in a portfolio is dramatically different from holding a security on its own. Consequently, the investor is generally concerned about the risk of an individual security only to the degree that it contribute to the variability in his total portfolio return.

Evans and Archer[1] in the first of many such tests examined the impact of the number of securities in a portfolio on the standard deviation of the portfolio's rate of return. Their methodology was to look at the annual rates of return on 470 common stocks listed on the New York Stock Exchange between 1958 and 1967. They then randomly[2] formed portfolios out of the securities and determined the standard deviation of the portfolio's rate of return. Portfolios were constructed of 60 one stock portfolios, 60 two stock portfolios and so on up until 60 forty stock portfolios. The average standard deviation for each portfolio size was then related to the size of the portfolio.

Evans and Archer found that the following equation best represented the relationship between portfolio size and the standard deviation of the portfolio's rate of return (σdenotes standard deviation).

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[1] J.M. Evans and S.M. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance (December 1968).

[2] Note that portfolios were formed randomly. Thus, it is naieve not "Markowitz" diversification, where securities are deliberately picked to reduce dispersion.

$$\sigma_p = 11.94\% + \frac{8.63\%}{n} \tag{9}$$

The interpretation is that the average standard deviation of a one stock portfolio (n=1) that is the individual security, was 20.57%. However, if you formed a two-stock portfolio (n=2) then the average standard deviation of its annual rate of return was only 16.26% that is a drop of 4.31%. As more stocks were added to the portfolio, the average standard deviation of the annual rates of return declined, although at a rapidly decreasing rate. Note that the average difference between a twenty stock portfolio and a twenty five stock portfolio was only 0.08%. That is adding an extra five stocks to the portfolio only caused the average portfolio's standard deviation to decline by 0.08%.

The implication of the Evans and Archer results, which have been replicated many times,[1] is that investors do not have to bear the variability risk of an individual security. By combining securities in portfolios, they are able to reduce the wealth variability that the investor is subejct to. This empirical observation suggests a convenient classification of risk. The individual security's total risk is the standard deviation or variance (σ^2) of the rate of return. However, from the Evans and Archer results we know that much of this fluctuation is diversified away when the security is held in a large diversified portfolio. Hence, that part of the security's variance that is eliminated by diversification into a large diversified portfolio is called unsystematic risk. The remainder of the security's variance represents the security's contribution to the increased variance of the diversified portfolio. This risk is called systematic risk. It represents that part of the fluctuation in the security's rate of return that is caused by

[1] See B. Solnik, "Why Not Diversify Internationally Rather Than Domestically?" Financial Analysts Journal (July-August 1974). Solnik shows that the Evans and Archer results generalize across all the major world financial markets.

factors common to all securities and which can thus not be removed by portfolio diversification

3. The CAPM Model

In the Evans and Archer model we noted that the standard deviation of the portfolio could not be reduced below about 11.4% by increasing portfolio size. In other words, regardless of the size of the portfolio, the investor has to bear a variability of return represented by a standard deviation of about 11.4%. This amount of variability does not depend on the size or composition of the portfolio. For this reason this minimum amount of variability is often called 'market risk'. If you increased the portfolio size to encompass all the securities in the securities market, then the standard deviation of the portfolio's rate of return would be the standard deviation of the 'market portfolio's rate of return, i.e., in (9) as n increases we approach the standard deviation of this market portfolio's rate of return.

The concept of a 'market portfolio' has played a key role in financial theory, since without any transactions costs or market imperfections we can see from the Evans and Archer data that an individual investing in risky securities would hold the market portfolio (or a close approximation) if he wished to minimize the risk attached to his investment. In this case, risk for an individual security is not the variability of the security's rate of return, but the security's contribution to the market portfolio's variability. This is the key insight reached simultaneously by Sharpe[1] and Lintner[2] in developing the capital asset pricing model. The CAPM states,

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[1] W.F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance (September 1964).

[2] J. Lintner, "Security Prices, Risk and the Maximal Gains from Diversification," Journal of Finance (March 1965).

$$E(R_j) = R_f + [E(R_m)-R_f]\beta_j \qquad (10)$$

where $\beta_j = COV(R_j,R_m)/VAR(R_m)$ = beta

E = expectations operator

R = rate of return

m,f,j = market, risk-free and jth security respectively

COV(-) = covariance function

VAR(-) = variance function.

Thus the expected return on a security, or the required rate of return for holding that security, is equal to the risk-free rate of interest plus a risk premium. This risk premium is the product of two quantities: (1) the covariance of the security's rate of return with the market portfolio divided by the variance of the market portfolio which is called beta; and (2) the excess of the expected return on the market portfolio over the risk-free rate of interest, which is called the market risk premium.

It is simplest to understand the meaning of the CAPM if we use the statistical definition of a covariance, i.e., $COV(R_j,R_m)=\rho_{jm}\sigma_j\sigma_m$ where $\rho_{j,m}$ is the correlation coefficient between security j and the return on the market portfolio. If we substitute in for beta we have,

$$E(R_j) = R_f + [E(R_m)-R_f]\rho_{jm}\frac{\sigma_j}{\sigma_m} \qquad (11)$$

If all securities are perfectly correlated then they all move identically up and down, that is $\rho=1$. In this case, the risk premium is equal to the product of the market risk premium and the ratio of the security's standard deviation to that of an average security. Risk has to be measured relative to some standard. The obvious standard for a security is the risk of the market portfolio.

Thus, if security j has more variability in its rate of return than the market, i.e., $\sigma_j > \sigma_m$, then the required rate of return on security j will be higher than that of an average security. This is essentially what Ibbotson and Singuefield found in the data across different types of securities, wehre a higher variability mean higher average returns.

If all securities <u>were</u> perfectly correlated the CAPM would be,

$$E(R_j) = R_f + [E(R_m)-R_f]\sigma_j/\sigma_m \tag{12}$$

However, all securities are not perfectly correlated, since different firms and industries react differently to general economic uncertainty as well as to factors unique to themselves. If we weight the risk premium in equation (12) by using the correlation coefficient between the security's and the market's rate of return we get,[1]

$$E(R_j) = R_f + [E(R_m)-R_f]\rho_{j,m}\frac{\sigma_j}{\sigma_m} + [E(R_m)-R_f](1-\rho_{j,m})\frac{\sigma_j}{\sigma_m} \tag{13}$$

We can now relate the CAPM through equation (13) to the Evans and Archer empirical results. Note that the risk premium in (12) has now become two terms, and this division provides us with the statistical definition of the ideas of systematic and unsystematic risk introduced in section II.

$$\text{Systematic risk} = \rho_{j,m}\frac{\sigma_j}{\sigma_m} = \text{beta} \tag{14}$$

$$\text{Unsystematic risk} = (1-\rho_{j,m})\frac{\sigma_j}{\sigma_m} \tag{15}$$

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[1]That is, we are just setting $x = \rho x + [1-\rho]x$ where x is the risk premium in (12) and ρ the correlation coefficient.

Hence, the CAPM only considers part of the variability of an individual security's rate of return. The part that it considers is called systematic risk.

The reason for the relevance of systematic risk is that this risk can not be removed by diversification into a portfolio of securities. Remember the Evans and Archer results, that after a certain number of securities the standard deviation of a portfolio's rate of return tended to stabilize at a level we called market risk. Systematic risk is determined by the covariance of the security's rate of return with the market rate of return and is the contribution of a security to this market risk.[1] Systematic risk represents the fluctuation in the rate of return on the market portfolio. Unsystematic risk is thus the random fluctuation in the security's rate of return, which can be completely removed by holding the security in a portfolio.

From the Evans and Archer data, the average standard deviation of a security's rate of return was about 20.54% and the average systematic risk was about 11.54%. Hence, since 'total risk' is usually defined as the variance of a security's rate of return (variance = σ^2), in the Evans and Archer data about 31% of total risk was systematic. This is about in line with what most empirical research has found and shows the tremendous gains to minimizing risk that are obtained by diversification.

The implication of the Evans and Archer empirical results is that since individuals diversify to reduce risk, the total risk of a security is not relevant to determining the required rate of return. The implication of the CAPM is that the only part of total risk that is relevant is the systematic risk. This tells us the security's contribution to the total risk of a

[1]Our discussion here is an intuitive motivation of the CAPM see S. Tinic and R. West, Investing in Securities: An Efficient Markets Approach, Addison-Wesley, 1978, p. 190, for a more thorough discussion of systematic risk and a security's contribution to the market portfolio.

diversified portfolio and thus that part of total risk that is unavoidable. Hence, the Sharpe-Lintner theory provides us with a theoretical model that allows us to incorporate the empirical observation of the gains to portfolio diversification. The CAPM operationalizes the Evans and Archer empirical observations by stating that in "equilibrium", the required rate of return on each security will be equal to the risk free rate plus a risk premium, determined for each security by its amount of systematic risk. Hence, assuming that we can estimate the amount of systematic risk, we can then estimate the security's required rate of return by adding to the known risk-free rate the estimated risk premium.

It is in this estimation process that Sharpe's 'beta' becomes important, since if we estimate the following equation,

$$R_j = \alpha + \beta R_m + \varepsilon \qquad (16)$$

(i.e., running a 'regression' of the security's rate of return against the rate of return on the market portfolio, where α, β are coefficients and ε a random error term) then the estimated coefficient on R_m is by its statistical definition equal to $COV(R_j, R_m)/VAR(R_m)$, which is the systematic risk variable in the CAPM, Eq. (10). Hence, the CAPM is usually specified with beta (β) as the systematic risk variable, since it is readily estimated by statistical techniques.[1] The use of the CAPM then becomes reasonably straightforward. The risk-free rate is estimated by the rate of return on default-free government bonds, the market risk premium is estimated by looking at the spread between equity securities and bonds (historically, 8.7% in the Ibbotson and Singuefield data) and the security's beta is estimated from historical data by a simple linear regression model.

[1] The regression equation is not precisely consistent with the CAPM systematic risk term see E. Fama, "Risk, Return and Equilibrium; Some Clarifying Comments," Journal of Finance (March 1968).

The CAPM thus holds promise as an alternative method for estimating the security's required rate of return. However, although it is an extremely elegant model and captures the spirit of portfolio diversification it does have weaknesses. Its theoretical derivation is based on a number of assumptions that do not exactly correspond to the actual functioning of financial markets.[1] Hence, the CAPM can not be used as a complete model of how required rates of return should be determined. However, if there is empirical justification for the model, this failure of the model's assumptions to hold exacly would not be important. Unfortunately, the empirical evidence does not support the use of the CAPM in equation (10) in a simple formula type approach.[2] The model has to be used with balanced judgement to account for the implications of the failure of the model's assumption to hold perfectly and the empirical observation that refinement is needed.

A further criticism of the model is that beta is almost always determined from rates of return in the capital market. This is not a direct result of the model, since beta is theoretically the covariance of the return on an investment with the return on all other investments, divided by the variance of the return on all other investments. Hence, beta should include all investment returns, such as public sector investments human capital etc. as well as private capital market investments. However, in practice beta is determined as a 'capital market beta'. This in turn can cause a conflict when the government is concerned with employment, since a project with a high capital market beta may not have a high employment beta. Hence, systematic risk from the private and social perspective may differ. We will return to this

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[1] See M. Jensen, "Capital Markets, Theory and Evidence," Bell Journal of Economics (Autumn 1972) for a summary of the CAPM's assumptions.

[2] See the following classic empirical test of the CAPM. E. Fama and J. McBeth, "Risk Return and Equilibrium; Empirical Tests," Journal of Political Economy 81 (1973).
R. Roll, "A Critique of the Asset Pricing Theory's Tests," Journal of Financial Economics 4 (1977).

problem in Section VIII when we show how employment and capital market betas can be in conflict. However, our immediate concern is to determine private valuation and for this the 'capital market beta' is the one relevant for determining the cost of equity capital.

4. Problems in Implementing the CAPM Model

Looking back at Eq. (10) we see that the determiniation of the yield investors require on a share involves three quantities: (1) the risk-free interest rate, R_F; (2) the premium of the expected return on the market portfolio over the risk-free interest rate, $E(R_m)-R_F$, and (3) the systematic risk on the share, beta. The problems of measuring each of these quantities are examined below.

(a) Risk Free Rate

The CAPM is derived under the assumption of a single period investment, that is, a simple today and tomorrow scenario. In this framework the risk-free security is simply the security that offers a given rate of return without any chance of failing to achieve that rate of return. In practice the only security that guarantees a given rate of return is a government security, which is default free, since the government can always fulfill its obligations through its ability to raise taxes or print more money! Hence, it is accepted that the risk-free rate should be the yield on government debt.

However, the problem does not resolve itself so easily, because in practice the investment world is not simply one of today and tomorrow, but one of today and tomorrow and tomorrow and tomorrow ...., and we have government debt that provides a risk-free rate of return between today and all of these tomorrows. This relationship between the rates of return on government debt of different maturities is called the 'yield curve'. A 'normal yield curve' would be one

where the rate of return on long-term government debt exceeds that on short-term debt, and an 'inverted yield curve' the reverse situation.[1] As of December 29, 1980 the yield curve could be represented by the following rates,

BOND	COUPON	MATURITY	BID YIELD(%)
Canada	8 3/4	June 1981	15.32
Canada	12 1/4	Oct. 1982	12.87
Canada	11 3/4	Dec. 1982	13.12
Canada	4 1/2	Sept. 1983	12.06
Canada	9 1/2	Oct. 2001	12.53
Canada	10 1/2	Oct. 2004	12.83

The yield curve shows that very short-term rates exceed longer term rates, but that the remainder of the interest rates were essentialy the same.

The problem introduced by the yield curve is that of deciding which risk-free rate is appropriate for determining the required return on equity. If we do not choose a risk-free rate that matches the investor's investment horizon we expose him to the possibility of capital gains and losses resulting from interest rate changes, and then the security is no longer risk free. In most applications of the CAPM the interest rate on 30 day treasury bills is used, since the parameters of the CAPM are usually estimated on 30 day rates of return. However, this implies a 30 day holding period, which makes the resulting required rate of return excessively sensitive to the fluctuation in short-term interest rates. In our analysis and example we will use a long-term interest rate, since common stock which does not have a 'maturity date' is likely to attract investors with an investment horizon a lot closer to long-term then to short-term government bonds. Usually, this distinction as to the choice of the risk-free rate is not material. However recently with the very high short-term interest rates experienced in the spring and winter of 1980, to have used short term rate would have resulted in an unrealistically high estimate of the required rate of return on common stock.

[1] For the best summary of the 'yield curve literature' see J.C. Van Horne, Function and Analysis of Capital Market Rates, Prentice-Hall, 1970.

(b) Expected Market Risk Premium

The most difficult piece of information to obtain and the greatest source of error in using the CAPM is the market risk premium. In principle, this is the excess of the expected return on the market portfolio, i.e., the market portfolio's cost of capital, over the risk-free rate of return. In the Ibbotson and Singuefield data presented earlier, this amounts to an average premium of about 8.7%. The reason for looking at this average over 52 years is that to use the average realized return on the market portfolio over just a few years would produce bizarre results. That is over a few years we may have a bull or a bear market that would produce an excessively high risk premium in the former case and an excessively low, even negative, risk premium in the latter case. Only by using an average over a long time period do we ensure that an average realized market risk premium is within the bounds of reason.

However, a figure within the bounds of reason may still be subject to a wide margin of error. The implicit assumption in using such a realized return is that the expected market risk premium is a constant over time and there is absolutely no reason to believe that this is so. In fact, there is evidence to suggest the contrary. As mentioned in the previous section, the yield curve, relating long and short term interest rates, fluctuates over time. Sometimes we have a normal yield curve and sometimes an inverted yield curve. Since common stocks have no maturity date, they are longer term securities than even long term bonds. Hence, we would expect the market risk premium, that is the share premium over long term bonds, to be almost as variable as the 'maturity premium' of long over short term bonds.

Moreover, Gordon and Halpern[1] have demonstrated that the market risk premium should theoretically vary with the expected rate of inflation. The

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[1] M.J. Gordon and P.J. Halpern, "Bond Share Yield Spreads under Uncertain Inflation," American Economic Review, 66 (September 1976).

reason being that with high expected rates of inflation, the uncertainty surrounding the future rate of inflation also increases. Hence, long-term bonds with a fixed nominal stream of interest payments, become very risky when judged in terms of required real return. The risk differential between equity securities and long-term bonds can thus be expected to decline relative to a less inflationary period.

In an effort to overcome some of the limitations of using the average realized return on the market portfolio, Brigham and Shome[1] have used the DCF method to estimate the expected market rate of return. The DCF method allows an updated accurate estimate of the expected market rate of return to be used with the systematic risk estimates to produce a blended estimate of the required rate of return on an individual security. Their estimates for the market risk premium are shown in Table IV-1 for the years 1967-1978. If these estimates are accurate, there is substantial variation in the expected market risk premium so that the use of an average could be expected to enduce a wide margin of error.

(c) Estimation of Beta

Values of beta, the covariance of the security's rate of return with that ofthe market portfolio divided by the variance of the market portfolio, are provided by many investment advisory services such as Value Line. Their estimates are invariably obtained by a simple linear regression of the monthly rate of return on the security against that of the market portfolio. However, what is

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[1] E. Brigham and D. Shome, "Estimating the Market Risk Premium," Working Paper University of Florida (July 1979).

TABLE IV-1

Estimation of the Risk Premium on the Market Portfolio

Year	DCF Return[1]	Risk-Free Interest Rate[2]	Risk Premium
1963	10.09%	4.21%	5.88%
1964	9.29	4.39	4.90
1965	9.23	4.39	4.84
1966	9.65	4.72	4.93
1967	11.06	5.51	5.55
1968	11.03	6.26	4.77
1969	11.51	6.59	4.92
1970	11.66	7.90	3.76
1971	11.16	7.56	3.60
1972	10.70	7.34	3.36
1973	10.17	7.36	2.81
1974	11.17	7.83	3.34
1975	14.42	8.89	5.53
1976	14.23	8.83	5.40
1977	14.81	7.88	6.93
1978	15.77	8.34	7.43
Average	11.62%	6.75%	4.87%

[1]From Eugene F. Brigham and Dilip K. Shome, "Estimating the Market Risk Premium." Working Paper, University of Florida, Gainesville, Florida, July, 1979, p. 30.

[2]Standard and Poor's AAA Public Utility Bond Interest Rate in December of the preceding year.

needed is not the historical beta, but the expected beta. This has lead to innumerable beta adjustment techniques to obtain a better estimate of beta.[1]

Further the empirical evidence does not support the assumption underlying the CAPM that investors hold perfectly diversified portfolios.[2] The problem then is that if portfolios are not perfectly diversified, individuals will be concerned with unsystematic as well as systematic risk. It is this recognition of imperfectly diversified portfolios that led Levy[3] to include the security's standard deviation as a determinant of its required rate of return, as well as its beta.[4] Levy's model is more general than the simple CAPM and will provide us with important insights on adjusting for risk in Section V and VI. In determining the required rate of return however, the beta adjustment techniques have implicitly corrected for the failure to include the standard deviation in the model. Hence, in estimating the required rate of return we will use the adjusted beta estimate in our simple CAPM.

One final concern in the estimation of beta from equation (15) is the specification of the market portfolio. In theory this market portfolio encompasses all risky assets, including such esoteric investments as 'human capital', gold, antiques, etc. In practice, the stock market index is used as a proxy for the return on the market portfolio of risky assets. The problem for a Canadian then becomes whether to use the TSE 300 index or the American Standard and Poor Index. If financial markets were perfectly integrated, portfolio investment would freely flow between the U.S. and

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[1]For one of the earliest and most popular adjustment models see M. Blume, "Betas and Their Regression Tendencies," Journal of Finance (June 1975).

[2]See M. Blume and I. Friend, "The Asset Structure of Individual Portfolios and Some Implications for Utility Functions," Journal of Finance (May 1975).

[3]M. Levy, "Equilibrium in an Imperfect Market," American Economic Review (September 1978).

[4]Levy cites the original empirical work of Douglas as empirical support for his model. E. Douglas, "Risk in the Equity Markets; An Empirical Appraisal of Market Efficiency," Yale Economic Essays, (Spring 1969).

Canada. The unfortunate implication of this would be increased U.S. ownership of Canadian industry! To try and finance Canadian projects with Canadian funds the federal government has introduced tax legislation such as the dividend tax credit that discriminates in favour of investment in Canadian securities. The existence of withholding taxes also serves to segment the U.S. and Canadian financial markets.[1]

The upshot of these barriers to portfolio investment flows is that most Canadian money is invested in Canadian securities and the North American financial markets are segmented. Hence, the correct market portfolio to use is the TSE 300 representing the market portfolio of Canadian securities.[2] In actual fact, the choice of the TSE 300 versus the S&P 500 is largely academic, since Lessard[3] has shown that given the common political and economic influence, they are very highly correlated. Moreover, Solnik[4] has shown that it is almost impossible to determine empirically whether security prices are determined domestically or internationally. The implication of this is that empirically it is impossible to determine whether a domestic beta is a better risk measure then an international (American) beta. Hence, in the application of the CAPM, we will use a conventional domestically determined beta, calculated via equation (15).

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[1] See M. Subrahmanyam, "On the Optimality of International Capital Market Integration," Journal of Financial Economics, 2 (1975) for a discussion of segmented versus integrated financial markets.

[2] A selection of estimated betas using the TSE 300 in Table V-2.

[3] D. Lessard, "World, Country and Industry Relationships in Equity Returns: Implications for Risk Reduction through International Diversification," Financial Analysts Journal (January-February 1976).

[4] B.H. Solnik, "Testing International Asset Pricing: Some Pessimistic Views", Journal of Finance (May 1977).

5. Separation of the Firm and the Individual

Financial markets exist to spread the risks of ownership among many individuals. In the extreme case of a world with no transactions costs we would have the conditions envisaged in the CAPM. In this case, risk is determined by beta and the covariance of the security's rate of return with the rate of return on the market portfolio. This would be because every investor in risky securities would hold the same market portfolio of risky securities. To adjust for individual attitudes to risk would then just require adjustment to the proportion of wealth placed at risk in the market portfolio. The implication of this model is that both the Bronfman family and a small entrepreneur in Orilla would both have the same fraction of their wealth invested in the Orilla business. This is clearly not true.

The CAPM definition of risk as systematic risk thus implicitly assumes that all individuals hold the same risky portfolio of securities. This risk is defined in the same way for all investors, since the risky investment decision is the same for all investors. Thus, when we use the CAPM of (10) to determine the cost of capital for a firm's investment decision we assume a complete separation of the firm from the individual, in that the calculation of the cost of capital is the same regardless of the specifics of share ownership.[1]

This implicit 'separation' assumption of the CAPM is appropriate for the case of large firms with multiple share ownership. In this case, the share ownership is widely held and investors hold diversified portfolios, even for small investors, since large mutual funds allows them to own indirectly a piece of General Motors, Northern Telecom and the like. Hence,

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[1]This is a well known result that was first put forward under certainty by Irving Fisher and is thus often known as the Fisher Separation Property. For a discussion of this see J. Hirshleifer, Investment, Interest and Capital, Prentice-Hall, 1970.

for large widely held firms we can accept the separation of the firm from the individual investor, a result which allows us to turn over the management of the firm to professional managers.

This is not the case however for the small publicly held firm and private firm where the equity may be concentrated in the hands of a few individuals. These individuals often find it impossible to diversify their own investment portfolio by reducing their ownership in their own

The basic problem here is that for small firms a substantial part of the value of the firm is the continued commitment of the entrepreneur to the firm. Very often small firms can only raise debt capital by a strengthening of the ties between the owner and the firm. That is lenders go outside the limited liability of the small corporation and ask the owner to put up some of his own private assets as additional collateral.

The reason for this behaviour is the moral hazard problem that arises if the owner-manager is able to reduce his ownership by selling equity to outside investors.[1] Typically when a substantial equity share is sold, it increases the tendency of the small business owner-manager to increase the amount of his perquisites. The reason is simply that the payment for the perquisites, such as a nicer office, extra secretarial help, more entertainment expenses etc., is now shared by the original owner-manager and the new investors. Hence, for the small business, it is in the interests of outside investors to maintain the close ralationship between the firm's profitability and the owner-manager's personal investment portfolio. The only alternative would be a costly monitoring and control system to ensure that the owner-manager does not strip the value of the firm by excessively endulging in perquisites.[2]

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[1] We will discuss moral hazard problems more generally in Section VIII.

[2] See M. Jensen and W. Meckling, "Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure", Journal of Financail Economics, (October 1976).

The upshot of this 'agency' problem is that small firms are usually managed by owner-managers who have most of their investment capital tied up in the firm that they run. In fact, some of these firms such as Ford Motor Company are not really all that small! The implication is that we no longer have this separation of ownership and control of the firm. Thus the CAPM emphasis on systematic risk does not tell the whole story. For the small firm the equity is provided by someone who does not own a diversified investment portfolio and thus is not concerned only with systematic risk. Thus, in equation (13) for the small firm the unsystematic risk is relevant for determining the cost of equity capital. For this reason, as we shall see in section VII the cost of equity is often substantially higher for the small owner-managed firm than for the large multinational, even when considering the same investment project.

V. ILLUSTRATIVE IMPLEMENTATION OF THEORY

Previous sections discussed the importance of the concept of the cost of capital, and the major theoretical approaches as to how it might be calculated. We have shown that utilizing either the DCF or the CAPM approach involves some subtle problems in application that can easily distort the resulting estimate. There are also some additional problems in calculating the cost of capital, in that the actual financing options available to the firm are not limited to simple debt and equity financing as we have hitherto implicitly assumed. Hence, in this section we take a prominent Canadian corporation, examine its financial structure, go through a step by step procedure to calculate its cost of capital, and examine how it is used to value a project.

The company that we analyze is Abitibi-Price Incorporated.[1] This company was chosen because it is the world's largest manufacturer of newsprint and is in many ways typical of the resource based character of Canadian industry. It is a major employer in Canada with 16,000 employees and a major contributor to Canada's favourable balance of trade. The annual capital budget, which has been as high as $150M, and the 'non-urban' character of much of Abitibi's production facilities mean that in many ways it is typical of the sort of firm that might approach the Labour Market Development Task Force for financial subsidies to enhance investment and employment.

The structure of our analysis is to first determine the cost of equity capital, secondly to determine the cost of debt capital and Abitibi's capital structure before finally determining Abitibi's overall current cost of capital, its weighted average cost of capital (WACC).

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[1] All of the analysis is performed on dates as of year end 1980. Hence, the merger speculations with Olympia and York has no impact on our analysis and conclusions.

1. DCF Cost of Equity Capital

We first apply the DCF method for determing the cost of equity capital. In Table V-1 we show a summary of Abitibi's operating and financial statistics from 1971 to the current period, and in Table V-2 Abitibi's 1979 income statement. The easiest part of the analysis in the DCF yield is to determine the dividend yield. With a $1.67 dividend per share and an equity share price of $24.50 as of January 2nd, 1981, Abitibi's current dividend yield is 6.8%. To project future dividends we need to determine Abitibi's long run growth rate in earnings and dividends. One thing we cannot use is the historic growth rate. For example the compounded annual growth rate in earnings per share between 1971 and 1980 was nearly 40%, while the compounded growth rate in dividends per share was just under 50%! The reason why we cannot simply extrapolate Abitibi's historic growth rate into the future is that Abitibi is a very cyclical stock. To understand the growth rate expectations for Abitibi we must understand the economic environment in which Abitibi operates.

First and foremost we must understand the nature of Abitibi's operations. In 1979 their operations by segment were,

Item	Pulp and Paper	Building Materials	Mining
Net Sales	1249	222	-
Operating Profit	219	5	11
Identifiable Assets	852	192	18

The mining segment represents the equity interest in the earnings of Mattabi Mines Ltd., and it is small enough to be largely ignored in the determination of Abitibi's growth potential. The remaining operations show that 85% of sales and 93% of operating profit in 1979 were derived from the pulp and paper business, the remainder from building products and lumber. Hence, Abitibi's growth potential can only be understood by understanding the economics of the pulp and paper industry.

TABLE V-1

Abitibi-Price 10 Year Financial Summary

	1980*	1979	1978	1977	1976	1975	1974	1973	1972	1971
Net Sales $M	1056	1471	1293	1036	877	761	552	404	308	279
Net Profit Margin %	5.95	7.75	6.07	3.65	1.48	1.81	8.32	7.4	2.76	1.76
Earnings per Share	4.48	5.67	3.96	1.74	0.47	0.63	2.50	1.62	0.43	0.23
Dividends per Share	1.67	1.5	0.95	0.35	0.12	0.4	0.65	0.275	0.07	--
Retention Rate (b)	0.59	0.74	0.76	0.58	0.68	0.37	0.74	0.83	0.84	1.0
Average Book Value**	24.3	20.73	17.22	15.13	14.32	14.06	13.05	11.5	10.68	--
Return on Equity (%)	18.43	27.35	23.0	11.5	3.3	4.45	19.16	14.08	4.03	--

*From interim nine month statement, figures are annualized where appropriate.

**Average Book Value figures are used, since ending book value reflects the retained earnings of that financial year and thus overstates the amount of equity invested throughout the year.

Source: 1970 Annual Report and 1980 Interim Report.

TABLE V-2

Abitibi's Consolidated 1979 Income Statement

	$1,000	
Net Sales	1,470,910	
Other Income	11,586	
		1,482,496
Cost of Sales	1,138,379	
Selling and Administrative Expenses	93,433	
Depreciation	49,441	
Interest Expense	23,473	
		1,304,726
Earnings Before Tax		177,770
Income Tax		68,046
Net Profit After Tax		109,724
Income from Other Companies		10,086
Minority Interest		5,706
Extraordinary Items		1,014
Net Earnings		115,118
Preferred Dividends		9,147
Earnings to Common		105,971
Number of Shareholders		18,701,030
Earnings per Share		5.67

Source: 1979 Annual Report.

The pulp and paper industry is a basic manufacturing industry that is characterized by high capital intensity.[1] Paper mills are usually very large and capital intensive and cannot be shut down very easily. As a result, the paper companies are often forced to sell their product at whatever price they can receive, since they have to keep operating to contribute towards covering their large fixed costs. This can be seen by the fluctuating profit margin for Abitibi in Table V-1. The implication is that demand conditions are particularly important for determining profitability, as strong demand translates into firm prices and a high operating rate and high capacity utilization. The demand for newsprint itself is a function of general economic conditions.

Abitibi's place in this general analysis is that Abitibi's timber resources are primarily in eastern Canada, at a time when the general drift of the North American timber market is towards the American south. Increasingly, it is the American South that is the low cost producer, primarily because of a shorter growing cycle. To compensate for this overall loss of competitiveness (comparative advantage still remains in some segments), Abitibi has made substantial capital expenditures to modernize existing mills and improve product quality. However, recent spectacular performance has been more the result of very strong industry demand and labour difficulties in the U.S. In addition, the decline in the value of the Canadian dollar has restored a decisive cost advantage in the short term. Indeed, 47% of 1979 earnings were the result of the exchange premium on U.S. sales and Abitibi estimates that a one cent decline in the exchange rate adds 20¢ to earnings per share. The Canadian dollar has plunged almost 19¢ from the high in 1977!

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[1] A good guide for any novice analyst in looking at an industry for the first time is the Paine-Webber Handbook of Stock and Bond Analysis published by McGraw Hill (1979). It is compendium of basic principles by industry analysts, edited by Kirwin Sokoloff.

We should thus consider the very high return on equity for 1979 as indicative of a particularly fortunate confluence of events. The 1980 performance has still been strong, since the U.S. printing industry had very slim stocks of newsprint. However, industrial problems plagued Abitibi throughout June and July of 1980, when strikes shut down plants and forced a monthly loss. For the medium term, the recession is beginning to reduce demand for newsprint and earnings will start their cyclical downturn. For the long term, the profitability of Abitibi depends crucially on the future value of the Canadian dollar.

To forecast the growth rate in Abitibi's earnings we have to consider Abitibi's recent performance in the light of these overall comments. The return on average equity figures in Table V-1 show the cyclical nature of Abitibi's performance and the strong impression made by the devalued Canadian dollar. However, no one buys Abitibi on the basis of current performance, since this cyclicality is well known. If we assume that the problems of the oil industry in Western Canada are solved, then the Canadian dollar should appreciate to the U.S. 90¢ range, almost where it was before recent political and economic events in the U.S. and Canada. On this assumption, the cyclical high in Abitibi's earnings per share would have been $1.40 less then the $5.67 reported in 1979, that is a return on average equity of 20.5%. In the long run, the cyclical nature of Abitibi's earnings would mean that this return on equity is not sustainable. However, provided some discount on the Canadian dollar is maintained, the cyclical lows should not be as bad as in 1971-72 and 1975-76. On this assumption, it is reasonable to expect that Abitibi could be expected to earn an average return on equity of 16%.

To determine the growth rate resulting from a 16% average return on equity, we need to determine Abitibi's retention rate. To understand the behaviour of the retention rate, we should note that investors have a preference for a stable stream of dividends.[1] Hence, corporations attempt to smooth any earnings fluctuation in the determination of the dividend per share. Abitibi for example did not increase its dividend proportionately with earnings in 1973-74 and 1978-79, since it was well known that those earnings represented cyclical highs. Instead, Abitibi chose to retain proportionately more of those earnings, so that in 1975 for example the dividend would not have to be cut proportionately with the cyclical downturn in earnings. In the long run it is evident that the retention rate averages out to about 68%. This is slightly higher then the average for industrial corporations, but partly reflects the needs of the industry in which Abitibi operates.

The application of the DCF equity yield would therefore suggest that Abitibi can sustain a long run growth expectation of 10.88%, that is a retention rate of 0.68 times an average return on equity of 16%. The current dividend of $1.67 can also be expected to increase in the near term with this long run growth expectation. Hence, we use an expected dividend per share as of year end 1980 of $1.83. The DCF equity yield for Abitibi is thus estimated to be 18.35%, comprising a long run expected dividend yield of 7.47% and a long run capital gains/growth yield of 10.88%.[2]

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[1] See the classic study by John Lintner, "Distribution of Income of Corporations Among Dividends Retained Earnings and Taxes," American Economic Review (May 1956).

[2] These figures seem reasonable. In the light of current inflation, they imply zero real economic growth. That is, Abitibi is a stable firm in a mature industry.

2. CAPM Cost of Equity Capital

The application of the CAPM requires a determination of the long run expected market risk premium. In Section IV-4 we discusssed why the expected market risk premium can be expected to vary over time, and consequently why it is incorrect to use a constant average over time. Underlying this variability in the market risk premium is the problem of the expected rate of inflation. It has been shown[1], that under uncertain inflation the rate of inflation reduces the equity risk premium. That is the premium of the expected return on the market over long term bonds declines. The reason for this phenomenon is that as the average inflation rate rises uncertainty about the future inflation rate increases, and the real return also becomes more uncertain. As the real return on bonds approaches the uncertainty of the real return on equity securities, the risk differential between long term debt and equity securities is narrowed. Hence, the expected market risk premium will tend to become smaller as inflation risk rises.

The estimation of the inflation risk is partly incorporated in the yield to maturity on long term bonds. Our data in Section IV-4 reveal that long Canada bonds were yielding 12.83% for a 23 year time horizon. The bulk of this 12.83% yield to maturity represents compensation for the erosion in purchasing power that comes with the expected rate of inflation. For instance, in the 1950's when the inflation rate was commonly under 3 percent the yields on long term bonds were rarely in excess of 6%. Hence, the information in the yield on long term bonds is that there is at present substantial inflation risk. Hence, we would expect a smaller market risk premium than the Ibbotson and Singuefield historic average of 8.7%. In these

[1] M.J. Gordon and P.J. Halpern, "Bond Share Yields Under Uncertain Inflation," American Economic Review, 66, (September 1966).

circumstances, the recent estimate arrived at by Brigham and Shomeof 4.87% seems more reasonable, and the figure we will use is 5%.

To apply the CAPM we thus have a 'long' risk free interest rate of 12.83% and a market risk premium of 5%. Hence, an average equity security should command an expected rate of return of about 17.83%. Abitibi however, is not an average equity security. Table V-2 provides some recent estimates for beta for a sample of Canadian firms. We see there that Abitibi's simple beta, estimated over a recent five year period, was 1.208, indicating that the rate of return realized from holding Abitibi equities was more volatile than for an average equity security traded on the TSE. Hence, application of the CAPM equation (10) would determine a cost of equity capital for Abitibi of 18.87% or about 1/2% higher than for the DCF equity yield. In view of the fundamental differences in approach in determining the DCF and CAPM equity yields, we can be confident that the actual equity yield for Abitibi is in the range 18-19%. In light of inflationary expectations of around 11% this represents a real yield of 7-8%, which brings the cost of equity for Abitibi in line with the normal equity yields prior to the increased inflation that began in the 1960's.

3. Abitibi's Capital Structure

To arrive at Abitibi's WACC the relative amounts of its various sources of funds at market value must be determined. The liability side of the company's 1979 annual report is reproduced in Table V-3. The current liabilities are not ordinarily considered part of the capital structure, and they are ignored.[1] The conventional securities, such as debt, preferred stock and

[1] We only look at long term sources of funds, because short term financing is reflected in net working capital, which is included in the investment cost in capital budgeting.

TABLE V-2

Estimates of Beta for Some Canadian Firsm 1976-80

Company	Beta	Average Monthly Rate of Return
Abitibi Paper	1.208	1.394
Brascan Ltd.	0.902	1.917
Canadian Pacific	1.124	2.107
Canadian Tire	0.811	-0.883
Dominion Bridge	0.633	1.815
Dome Petroleum	1.346	3.872
Electrohome	1.304	1.585
Falconbridge Co.	1.787	1.187
Hudson's Bay Co.	0.914	0.757
Husky Oil Ltd.	0.568	6.310
Imperial Oil Ltd.	1.287	0.875
Labatt, John L.	0.738	0.451
Macmillan Bloedel	1.002	0.860
Massey-Ferguson	0.670	-1.352
Murphy Oil Co.	1.491	3.382
Norcen Energy	1.319	2.275
Northern Telecom	0.799	0.572
Steinberg's Ltd.	0.609	0.285
Simpson-Sears Ltd.	0.687	-0.372
Texaco Canada Ltd.	0.935	2.007
Seagram Co. Ltd.	1.165	1.473

Source: Financial Models Co. Ltd.

TABLE V-3

Abitibi's Consolidated 1979 Balance Sheet

Assets	
Cash	$ 1,000
Account's Receivable	76,454
Inventories	217,309
PrePaid Expenses	229,223
	7,595
Net Fixed Assets	588,702
Other Assets	64,416
Total Assets	$1,183,699
Liabilities	
Bank Loan	5,534
Accounts Payable	153,257
Other Short Term Payables	32,669
Deferred Income	57,612
Long Term Debt	237,726
Preferred Income Taxes	103,117
Minority Interest	24,465
Preferred Stock	143,000
Common Stock	54,826
Retained Earnings	371,494
Total Liabilities	$1,183,699

Source: 1979 Annual Report.

common stock present no problems, since we can determine their market values and their opportunity cost. However, we need to discuss the non-conventional 'sources of funds'; the deferred income, minority interest and deferred income tax amounts.

(a) Deferred Income

In 1978 Abitibi purchased Labrador Linerboard Ltd. from the province of Newfoundland for $40.9M. The main asset in the acquisition was the Stephenville mill, which is now being converted from a linerboard mill to a newsprint mill. At the time of purchase, Labrador Linerboard had unused capital cost allowances (depreciation) of $164.1M in excess of the purchase price. The $44.873M represents the reduction in future taxes resulting from the application of these 'excess' capital cost allowances against current and future income. This in effect means that the equity holders will retain more of the taxable income, as taxes paid are reduced by this deferred income. The value of this deferred income is therefore already reflected in the market price of the common stock. The balance sheet account deferred income is just an accounting entry under the cost method of accounting. The economic entry has already been made by revaluing the market value of common stock to reflect the present value of this deferred income. Hence, this account is ignored in calculating the cost of capital.

(b) Minority Interest

This account represents the book value of subsidiary assets that have been fully consolidated by Abitibi, but are not 100% owned by Abitibi. To the extent that the earnings of these subsidiary operations have already

been reduced to reflect the minority ownership, no further adjustment is required. Hence, the minority interest is ignored in determining Abitibi's cost of capital, since we have already netted out the required earnings on this minority interest.

(c) Deferred Income Taxes

Deferred income taxes arise from timing differences between tax accounting and generally accepted accounting principles (GAAP). The income statement reflects taxes that should be paid according to GAAP. However, the government allows faster write-off of many pieces of equipment than is allowed by GAAP. Hence, taxes actually paid are lower than taxes that should be paid according to GAAP. The difference is deferred income taxes which represent the reduction in taxes actually paid each period. This income statement figure is credited to the balance sheet liability deferred income taxes. When the timing difference reverses itself and taxes actually paid the government exceed those determined by GAAP, this balance sheet account is then reduced.

Deferred income taxes in effect represent a cost free loan from the government, which is automatically paid off over the life of the equipment as the timing differences reverse themselves. In practice, growing firms that continually add to their pool of assets can often defer actual repayment indefinitely. Hence, the practice in public utility regulation is to enter deferred income taxes as a cost free source of funds, which effectively passes the benefit on to the consumer. For the non-regulated firm this process is not correct. Since the firm's earnings are not constrained by a regulatory commission, any reduction in income taxes increases the cash flow to the common equity and value increases. Moreover, in a competitive

industry this 'advantage' is often bid away through price cutting. Hence, the effect of the deferred income taxes is in part a higher value for common stock and in part lower reported earnings. To include the deferred income taxes in the cost of capital for a non-regulated firm would thus be to double count.[1]

The conclusion of this discussion is that the cost of capital is determined by examining the cost of long term funds raised from private investors.

4. Abitibi's Cost of Capital

The cost of capital is just a weighted average of the costs of different sources of long-term funds, where the weights are the proportion of each source of funds in the firm's market value. Because of the complexity of the capital structure of Abitibi, we reproduce in Table V-4 and V-5 the complete description of the stockholder's equity and long term debt accounts contained in the 1979 Annual Report. To arrive at the market value for each class of security, the number of shares, bonds, etc., must be multiplied by its market price. For the common stock we have a market price, and the figure used was $24.50, the price on January 2, 1980.

Only some of the outstanding preferred stock and long-term debt instruments were publicly traded. The 7 1/2 percent A preferred had a market value of $35.125, and the 10 percent B preferred had a market value of $47.00. The series C preferred was not publicly traded. It provided a floating rate dividend of up to 9 percent, and the series A and B yield of 10.64% was used to arrive at an imputed market price of $42.50. The series D is held by the

[1] In the capital budgeting process the firm calculates the cash flows net of accelerated depreciation. This also implies that including the effect in the cost of capital would be double counting. However, eliminating the reserve for deferred taxes also implies that the deferred tax expense should be included in earnings for the calculation of the expected growth rate--insofar as it is expected to continue. Hence, there is a slight downward bias in our estimate of growth and the cost of equity capital.

province of Newfoundland and has no dividend payment, but it is being retired in each of the years up to 1984. If this series D were traded it would also require a 10.64% yield and would have a market value of $22.9M, rather than the $27.5M listed on the balance sheet. Hence, this was the imputed value used.

The debt included in the capital structure comprised the items listed in the 1979 annual report (Table V-5) plus the $147.8M in debt that was issued during 1980. The only debt issue publicly traded was the 9 3/4% 1990 issue, since much of the remaining debt consisted of instalment loans that are privately held. Since the 9 3/4% 1990 issue is broadly representative of Abitibi's debt its market price of $79.875 and its yield of 13.64% was used to value the existing debt and the newly issued debt was valued at par.[1]

Applying the above price data to the amounts of each security outstanding resulted in the following capital structure at market value.

Item	Amount (000)	Percent
Long Term Debt	$327,340	50.6%
Preferred Stock	119,100	36.2
Common Stock	458,180	13.2
Total	$904,620	100.0

The costs of the various financing sources are the 10.64% yield for the preferred stock, 13.64% for the long term debt and 18.5% for the common stock. Abitibi's tax rate is approximately 40%. Hence, the calculation of Abitibi's overall cost of capital is,

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[1] For an actual calculation, each debt issue would be valued independently. Since the purpose of this example is illustrative, this technical analysis will not be shown here. The result is that the proportion of debt financing is not completely accurate.

TABLE V-4

Shareholders' Equity

	1979	1978
Preferred Shares Issued by a Subsidiary Company (note 8)	—	75,000
Stated Capital (note 8):		
Preferred shares—		
Series A— 169,990 shares (1978—174,290 shares)	8,499	8,715
Series B— 640,000 shares (1978—680,000 shares)	32,000	34,000
Series C—1,500,000 shares	75,000	—
Series D— 550,000 shares	27,500	—
Class A shares	—	—
Common shares—18,701,030 shares (1978—18,668,244 shares)	54,826	54,826
Retained Earnings	371,494	293,562
	569,319	466,103
	$1,183,699	$1,072,463

Source: 1979 Annual Report.

TABLE V-5

Long-Term Debt

	1979	1978
Abitibi-Price Inc.:		
Sinking Fund Debentures—		
5¼% Series A, maturing 1985	$ 10,820,000	$ 11,977,000
7¼% Series B, maturing 1987	8,168,000	9,492,000
9¾% Series D, maturing 1990	10,399,000	11,940,000
10½% Series E, maturing 1995	40,950,000	42,500,000
11% Series F, maturing 1995	13,180,000	14,210,000
11⅜% Series G, maturing 1995	69,996,000	71,148,000
10.15% Series H, maturing 2000	14,758,000	—
Abitibi-Price Corporation and subsidiary companies:		
Revolving Bank Credit bearing interest at lender's prime rate	9,333,000	9,486,000
Instalment Note bearing interest at ⅝% above lender's prime rate, maturing 1981	1,750,000	2,668,000
5⅛% Instalment Notes, maturing 1984	6,183,000	7,115,000
5½% Instalment Note, maturing 1986	8,166,000	9,486,000
7⅜% instalment Notes, maturing 1988	12,833,000	14,230,000
5¼% Instalment Note, maturing 1991	3,054,000	3,297,000
Other notes	2,251,000	3,723,000
The Price Company Limited and subsidiary companies:		
Sinking Fund Debentures—		
5¾% Series A, maturing 1982	5,800,000	7,500,000
6¾% Series B, maturing 1987	15,700,000	18,300,000
5½% Sinking Fund Notes, maturing 1985	7,793,000	9,237,000
6% Sinking Fund Notes, maturing 1986	3,733,000	4,364,000
Other indebtedness	862,000	1,383,000
	245,729,000	252,056,000
Less Amount due within one year	8,003,000	10,891,000
	$237,726,000	$241,165,000

Source: 1979 Annual Report.

Item	After Tax Cost	Weight	Contribution
Common Stock	0.185	0.506	0.0936
Long Term Debt	0.0818	0.362	0.0296
Preferred Stock	0.1064	0.132	0.0140

Hence, the after-tax weighted average cost of capital for Abitibi is approximately 13.72%. That is in evaluating investment projects of a similar risk to those already in place, Abitibi should use a discount rate of 13.72%. Any project that offers an expected rate of return of less than 13.72% will cause Abitibi's common stock price to decline and should be rejected.

5. Project Evaluation

The value of a project is arrived at by discounting the future cash flows with a rate appropriate to the risk of the project and comparing the value and cost of the project. The greater the excess of project's value over its cost the more attractive the project. For a project that Abitibi might undertake going from the WACC for the company to the discount rate or WACC that should be used on the project is likely to pose no problem. We have seen that 85% of sales and 95% of operating profit for Abitibi are derived from its pulp and paper operations. Hence, any large scale project that Abitibi might undertake is likely to be a pulp and paper mill, and the appropriate discount rate for arriving at the value of another such mill is the company's overall WACC.

However, Abitibi might consider expansion in the building material or the mining industries, and insofar as the risk of a mill or mine in those industries is different, a different discount rate would be appropriate. More generally, a conglomerate might have three divisions, an insurance division, an engineering division and a consumer products division. Each of these divisions, if it were a separate company could have a required rate of

return on common equity reflecting its own risk. The insurance division reflecting the risk of a financial institution might have a required rate of return of 12%, the engineering division reflecting the cyclicality of the capital goods sector a required rate of return of 22%, and the consumer goods division reflecting the sensitivity to aggregate consumer spending a required rate of return of 16%. However, the DCF method would only allow an estimate of the average required rate of return of say 17%, reflecting the investor's perception of the risk of all three divisions and their relative contribution to the risk of the firm. If the firm were to use its average required rate of return on equity of 17% to calculate a cost of capital, for the engineering division it would tend to overvalue projects and for the insurance division undervalue projects. Hence, for efficient decision making, the required rate of return on equity and cost of capital must be adjusted for the risk of each project and division.

The DCF and the CAPM methods differ in their relative usefulness for arriving at the cost of capital for a division of a firm that is not typical of the firm as a whole. The DCF method provides an estimate of a firm's cost of capital without also providing any explanation for the figure. It is exactly like the practice in measuring bond yields. Given the price of a bond, its yield is the discount rate that equates the promised interest and principal payments with the price. Given the price, coupon, principle and maturity of two bonds, we may measure their yields with a high degree of accuracy. The two yield figures may be different, but the measurement process does not tell us why. More important, these two yield figures do not tell us what the yield should be on a third bond that is not publicly traded and for which no price is known.

Hence, the DCF method is of limited use for a company that is not publicly traded or for a division of a company, since the latter is also not publicly

traded. In both of these cases the DCF method can only be used in a roundabout and qualitative manner. We look for a publicly-traded company that is solely in the same business as the nontraded company or the nontraded division of a conglomerate. We then estimate the cost of capital for the other traded company and then use of our judgement to adjust this figure up or down to fit the risk characteristics of the nontraded company or division. The qualitative adjustment based on judgement is open to question and in addition with the rise of conglomerates it is increasingly difficult to find a traded company that is solely or predominantly in the industry of interst.

By contrast, the CAPM arrives at the cost of capital by assessing the firm's fundamental risk characteristics rather than just measuring their implications. This has some unique advantages. First of all it enables us to explain variations in the required rate of return between different companies. While the DCF method measures such differences without telling us the reasons for them, the CAPM tells us that if Firm A's rate of return has a larger then average standard deviation with a high correlation with the rate of return on the market portfolio, then it will have a higher than average required rate of return. This is because the investor holding Firm A's security will find that it adds relatively more to the riskiness of his investment portfolio because of the close movement of the security's rate of return with the rate of return of his existing portfolio there are very few diversification benefits.

The CAPM enables us to estimate the required rate of return on a share by relying on the risk determinants of its required rate of return.

Rosenberg and Guy[1] show how beta and the CAPM required rate of return can be inferred from 'investment fundamentals'. They relate beta to the various sources of uncertainty in the economy and the firm's sensitivity to these particular sources of uncertainty. However, their work as yet is mainly of theoretical, rather than empirical interest. Gordon and Halpern[2] on the other hand, have developed estimation procedures for beta based on the division's earnings. Hence, the required rate of return can be calculated via the CAPM for a division within the firm.

A unique advantage of the CAPM, therefore, is that it allows a firm with a variety of divisions, each with different risk, to structure a set of required rates of return for equity investments in each division. From these required rates of return, and an assessment of the amount of debt financing permissable in each division, the firm can construct a set of divisional costs of capital. These divisional costs of capital,[3,4] or 'hurdle rates' as they are often called, allow the firm to more accurately assess the value contributed by accepting a new investment project, even when that investment project differs in terms of risk from that of the average or normal project undertaken by the firm.

A major project undertaken by a firm is quite likely to have the same risk as the overall risk of the division in which the project falls. However, that will not always be the case. For instance, a mine in a third-world country with an unstable political structure will be far riskier than

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[1] B. Rosenberg, and J. Guy, "Prediction of Beta From Investment Fundamentalists," Financial Analysts Journal (May-June 1976).

[2] M.J. Gordon and P.J. Halpern, "The Cost of Capital for a Division of a Firm," Journal of Finance (September 1974).

[3] G. Donaldson, "Strategic Hurdle Rates for Capital Investment," Harvard Business Review (March-April 1972).

[4] R. Bower and D. Jenks, "Divisional Screening Rules," Financial Management (Autumn 1975).

the same mine in Canada. We will see later that the riskiness of a plant will depend on its labour-capital ratio. Other attributes of projects can make seemingly identical projects differ considerably in risk and required rates of return. In principle the CAPM can be used to arrive at the differences in risk and required rate of return among projects in the same industry. In practice, the available data on a project does not allow the straightforward application of the CAPM to the task with any reliability. However, the theory underlying the CAPM may be used to make informed judgements on how a DCF or CAPM yield on a publicly traded firm or on a division should be adjusted to arrive at the cost of capital for a project.

For example, for Abitibi-Price we saw that there are basically three business segments, with 93% of operating income stemming from the pulp and paper division, 2.1% from the building products and lumber division and 4.7% from the mining interest in Mattabi mines. We generally emphasized the importance of the pulp and paper division in determining Abitibi's cost of capital. However, how should we determine the cost of capital that Abitibi should apply to evaluate a request for an expansion in its building product and lumber division?

To determine this, we must look at the economic environment of the forest products companies. Essentially, although still a "wood products" operation, building products and lumber are very dependent on the level of housing activity. In the long run, this is determined by demographic changes and real income charges. In the short run, however it is highly dependent on the level of interest rates and the availability of credit. The 1979-80 period has been characterized as one of high interest rates, which has resulted in a severe contraction in the number of new housing starts. The decline in the value of the Canadian dollar has been of little

value to Abitibi, since both the U.S. and Canadian construction industries have been depressed by the high interest rates.

These general industry conditions are reflected in Abitibi's capacity and production figures,

	Newsprint	Uncoated Papers	Fine Papers	Paperboard & Pulp	Building Boards	Lumber
Capacity	1,961,000	370,000	205,000	307,000	977,000	441,000
Production						
1979	1,961,000	370,000	202,000	247,000	848,000	360,000
1978	1,962,000	292,000	181,000	297,000	935,000	356,000
1977	1,694,000	231,000	157,000	271,000	904,000	324,000
1976	1,711,000	211,000	113,000	247,000	854,000	272,000
1975	1,148,000	129,000	77,000	162,000	733,000	130,000

Evidently, the newsprint, fine paper and uncoated paper production figures show production at full capacity and paperboard and pulp production at 80% of capacity. These figures reflect the continued strong demand for paper products from the bouyant economy and devalued dollar. On the other hand, building boards are at only 86.7% of capacity and lumber at 81.6% of capacity, showing the effects of high interest rates on construction activity and the derived demand for building products.

To determine the cost of equity for the building products division, we can adopt two approaches. The first is to consider an equivalent company more engaged in the building products division. MacMillan Bloedel is an obvious source of comparison, since their segment operations are broken down as

	Building Materials	Pulp & Paper	Linerboard
	$M		
Sales	1,176.5	672.4	414.0
Earnings	155.4	122.5	26.9

Hence, the building products division contributes 50.6% of MacMillan Bloedel's earnings and the rest 49.4%. This is a greater emphasis on the production of raw materials and building materials than in Abitibi-Price.

From our beta statistics in Table V-2 we determine Macmillan Bloedel's beta to be 1.002. Hence, the CAPM required rate of return for an equity investment in MacMillan Bloedel can be estimated to be 17.84%,[1] compared to the 18.87% CAPM estimate for Abitibi-Price. If we assume that Abitibi's newsprint business is contributing excessively to current earnings and that a value contribution to Abitibi is more in line with the sales proportion of about 15%, then we can say that MacMillanBloedel and Abitibi's required returns are determined as,

$$17.84 = 0.5\ E(R_{Bp}) + 0.5\ E(R_{pp}) \tag{18}$$

$$18.87 = 0.15\ E(R_{Bp}) + 0.85\ E(R_{pp}) \tag{19}$$

where $E(R_{Bp})$ is the expected return on the building products division and $E(R_{pp})$ is the expected return on the paper production division. That is we are saying that Abitibi's required rate of return is comprised of 85% of an investor's required rate of return in a paper products firm and 15% of an investor's required rate of return in a building product's firm, whereas Macmillan Bloedel's is 50-50. The implicit simplification here is that an investor is indifferent between Abitibi's and Macmillan Bloedel's respective divisions. If we would find a company with just a building product's division, we would not have to go through this weighted average calculation, but the increasing trend towards conglomerate mergers makes such a technique inevitable.

Given the two equations (18) and (19) and only two unknowns, the required returns in the two divisions, we can solve to find,

$$E(R_{Bp}) = 16.35\%$$

$$E(R_{pp}) = 19.31\%$$

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[1] We suppress most of the analysis to avoid duplication of that already performed by Abitibi-Price.

Hence, assuming that individuals buy Abitibi and MacMillan Bloedel as alternative ways of buying newsprint and building material companies, the required return on an equity investment in each of their divisions is 16.36% for the building products division and 19.31% in their newsprint, pulp and paper division.

The second method for determing the cost of equity in the building products division is through fundamental risk analysis. To build a new sawmill with an annual capacity of 300 million feet in 1979 cost about $45M, and would generate about $60M in revenues. That is the asset turnover ratio is about 1.33. In the newsprint business however, paperboard mills can cost up to $250M and will only generate sales of about $70M per year, an asset turnover ratio of 0.28. Hence, capital committed to the newsprint business is more dependent on future profitable sales, that is a strong profit margin, to maintain an acceptable return on investment. We have seen that for Abitibi-Price the profit margin is highly variable and has only remained strong recently because of the decline in the value of the Canadian dollar. Building materials on the otherhand, are sensitive to interest rate charges, which, except for the recent very high rates, have not been so volatile as the factors affecting the newsprint business. Hence, fundamental risk analysis would dictate a higher required return in the newsprint division than the building products division, despite the recent sluggish performance in the building products division and spectacular performance in the newsprint division.

Abitibi-Price should thus set up hurdle rates to differentiate between investments in building products and investments in newsprint, based on a 16.36% required equity return in the building products division and 19.31% required return in the pulp and paper/newsprint division. Moreover, MacMillan Bloedel's debt ratio is 52.6% compared to Abitibi-Price's 52%. Hence, for simplicity we assume that the same capital structure is applied to finance

a project in Abitibi's building products division as is used to finance the firm as a whole. Hence, the hurdle rates or divisional costs of capital are calculated by substituting 19.31% and 16.36% for the equity cost in the calculations used to calculate Abitibi's overall cost of capital. The results are for the building products division a cost of capital of 12.64% and for the newsprint/pulp and paper division a cost of capital of 14.13%.

The preceding example is meant to show how divisional costs of capital can be calculated given two companies with broadly similar divisions, but with a different degree of concentration. The results are suggestive in showing that although Abitibi's overall cost of capital is 13.72%, its building products division, because of the lower risk, should have a lower cost of capital of 12.64% and the pulp and paper division a higher cost of capital of 14.13%. That is by using Macmillan Bloedel, we are able to refine the divisional estimates, because of the additional information. Our analysis rests, however, on several strong assumptions, in particular that the two companies only have the two types of divisions, whereas in fact we have already seen that Abitibi does have a small mining interest as well. Hence, we should not be led into thinking that we can actually calculate the cost of capital for any division to two decimal places. With the present level of analysis, we would say that the building products division should have a cost of capital of about 13% and the pulp and paper division 14%.

VI. ECONOMICALLY UNACCEPTABLE PROJECTS

1. Value of a Project

To make concrete our consideration of the possible problems and the solutions that are posed for economically unacceptable projects, that is for projects on which the present value of future cash flows are below the cost, assume a project with the following risk and return properties. The risk properties make the cost of capital that should be used in placing a value on the project 14 percent if the firm's policy in financing investment is to rely solely on common equity funds. The tax and other advantages of debt financing make the WACC for the project 12 percent on the basis of a 40/60 debt-equity ratio and a 40 percent corporate tax rate. The 12 percent WACC is arrived at as follows.

Source	Relative Amount	Cost Rate	After Tax Cost	Weighted Cost
Debt	.40	.125	.075	.03
Equity	.60	.150	.150	.09
Total	1.00			.12

The relative amounts of debt and equity and the cost rates from each source may be arrived at by the methods described in Sections III and IV. Alternatively, if the project is considered materially different in risk from the firm as a whole, the capital structure and the cost rates may be adjusted accordingly on the basis of judgement, or the available data on risk and the CAPM as described Sections IV and V.

The cash flow information on the project that has been obtained is as follows:

- Initial cost $15M
- Cash flow before depreciation, interest and taxes is expected to be $1M for the first three years after the investment is completed and $3M per year in years 3 to 15

- Depreciation is charged on a straight-line basis of $1M per year
- Corporate income tax rate is 40 percent

The expected cash flows on the project after taxes but before interest and its tax implications are:

Item	Years 1 to 3	Years 4 to 15
(1) Cash flow after depreciation	0.0M	2.0M
(2) Less income tax @ 40 percent	0.0M	.8M
(3) Plus depreciation	1.0M	1.0M
(4) Cash flow including tax and depreciation	1.0M	2.2M

The present value of these expected cash flows on the basis of a 12 percent WACC, which accounts for the tax and interest rate benefits of the 40/60 capital structure used to finance the project is:

1.0M in years 1 to 3 based on an annuity factor of 2.402	$ 2.402M
2.2M in years 4 to 15 based on an annuity factor of 4.409	9.699M
	12.101M

This project has a present value that is $2.9M short of the $15M investment required to undertake the project. Stock worth $9M will have to be given to the investors who provide the equity capital or $9M worth of earnings will have to be retained, but the common equity will increase in market value by only $6.1M.

If the firm is efficiently managed this $15M project will not be undertaken. However, it might very well be the case that this project is socially acceptable. For example the project might be a marginal mine in a rural community that has little alternative industry. Hence, the government might be faced with the problem that if the project is not undertaken, then the community will gradually wind down. The more elderly and less productive workers might remain and go on welfare and the young productive workers will migrate to other regions. From the government's point of view this might mean

increased welfare payments, increased urban and rural stress due to migration and inadequate use of expensive infrastructure installed under the assumption of continuing employment. From the social point of view the costs imposed on society at large by the private decision not to invest could be many times the cost imposed on the shareholders by investing in an unprofitable project. This is an 'externality' imposed on society as a result of the private investment decision.

The consideration of social costs and benefits is one part of an approach to public decision-making called cost-benefit analysis. This report will go no further than assuming that such an analysis has been completed to justify the need for government incentives to encourage the firm to accept the project. Hence, we only need to consider what the government has to do to encourage the firm to undertake the project. Obviously, if the common stockholders lose $2.9M if the project is undertaken, the very minimum required is that the government, on behalf of society at large, compensate the private shareholders for this amount. Hence, a government policy has to resolve the problem of how to transfer $2.9M to the firm's common stockholders. Otherwise, short of direct government control or malevolence there is no way of enducing the firm to waste its owner's financial resources.

2. Types of Financial Inducements

Essentially there are three ways in which the government can induce the firm to undertake the above project. They are: (1) a cash grant, (2) a low cost loan, and (3) an annual operating subsidy. They are examined below.

(a) Cash Grant

The simplest and most direct way a firm can be persuaded to undertake an economically unattractive project is to give it a cash grant equal to the

shortfall in its present value. With the project's cost $15M and its present value $12.1M based on the 12 percent WACC, the required grant is $2.9M.

If the project were looked on as being all equity financed the cost of capital would be 14 percent, the project's present value would be $10.7M, and the required cash grant would be $4.3M. Conversely, under the Modigliani Miller assumptions on the relation between capital structure and cost of capital, a high debt ratio would result in a lower cost of capital, a higher present value, and a lower subsidy. The rational for the 40/60 debt equity ratio is that it represents the optimal capital structure, either because it minimizes the WACC or is a reasonable trade-off between the risk and return of raising the debt ratio.

The cash grant, it may be noted, need not take the form of a direct payment to the firm. The same objective can be achieved by having the government assume the cost of a corresponding part of the required investment. For example, the government could provide some of the infrastructure such as a new road, or it could pay the cost of training new personnel to be employed by the firm. It should be added that with the grant of $2.9 in one form or another, the firm raises $12.1M in debt and equity to maintain its overall 40/60 debt-equity ratio.[1]

(b) Low Cost Loan

A second way the government can make the project economically profitable is by providing a low cost loan via one of its financing organizations such as FBDB, the Federal Business Development Bank. Assume that the government provides the firm with a 15 year loan of 7.0M @ 6 percent interest. The

[1]That is the firm raises $4.84M in debt and $7.26M in equity. The cash grant of $2.9M added to the $12.1M raised privately finances the $15M investment.

present value of the interest and principal discounted at 12.5 percent is about $4M, so that the loan at this interest rate provides an implicit grant of $3M. In other words, borrowing $7M at 6 percent imposes no greater burden on the firm than borrowing $4M for 15 years at 12.5 percent.

With the $7.0 M obtained through the loan, the firm need raise only $8M through equity. However, this financial package does not result in an increase in the firm's debt-equity ratio. The risk of a corporation's debt increases with its interest rate as well as its principal amount. In fact a loan with a zero interest rate that is a consol (no maturity date) is a gift. Accordingly the debt-equity ratio is properly measured on a market value basis. Hence, with this low-cost loan the debt-equity ratio is reduced to 33/67, and the amount of the subsidy is raised correspondingly.

(c) Operating Subsidy

An operating subsidy is the third way that the government can induce the firm to undertake the project. An annual subsidy that increases the after-tax cash flows by an amount that has a present value of $2.9M is required. With the after-tax interest rate of 7.5 percent an annual subsidy of $328,535 is required. However, the contract for the subsidy must make it as certain as the public debt. Otherwise, its value to the company would be arrived at by discounting the expected amounts of the annual payments at a higher discount rate, resulting in a smaller present value per dollar of annual subisdy.

How the government structures its support for a firm can influence the firm's behavior, but it is also a matter of political expendiency. Governments would ordinarily prefer short-term, low-cost loans or operating subsidies that are reviewed annually. In this way the benefit to the firm can

be related to its performance relative to the government's employment objectives. The firm on the other hand may be fearful that changes in government policy will result in termination of the support notwithstanding excellent performance. The "cleanest" solution for the firm is a cash grant, and the next best alternative is a long-term loan with an equivalent present value. Political expediency makes governments prefer low cost loans which are often not perceived to be a "gift" to industry in the same way as a cash grant. Government expenditures which appear to benefit a wider constituency than the firm are also politically more expedient than cash grants.

VII. FINANCIALLY UNACCEPTABLE PROJECTS

To make concrete the possible problems and solutions in the case of a project that is financially unacceptable, let us once again create an illustrative example. Assume the same project that was discussed in Section VI except that the cash flows are $1.0M for years 1 and 2 and $5.0M for years 3 to 15. The after-tax cash flows are:

	Years 1 and 2	Years 3 to 15
Earnings after depreciation	0.0M	4.0M
Less income tax at 40 percent	0.0M	1.6M
Plus depreciation	1.0M	1.0M
Cash flow including tax and depreciation	1.0M	3.4M

For a firm with the 12 percent cost of capital arrived at in Section VI, the present value of these cash flows is:

1.0M in years 1 and 2 based on an annuity factor of 1.69	$ 1.690M
3.4M in years 3 to 15 based on an annuity factor of 5.121	17.411M
Total Present Value	$19.101M

This project has a present value that exceeds its cost for a firm that has a 12 percent cost of capital with a 40/60 debt/equity ratio. The common shareholders could expect an increase in the market value of their stock of $4.1M when the project is undertaken. That is increasing the common equity by $9M through the sale of stock[1] would raise the market value of the outstanding shares by $13.1M with the difference going to the existing shareholders.

No government support is needed to persuade a firm to undertake the above project if it has a 12 percent cost of capital with a 40/60 debt/equity ratio, and if maximizing the market value of common equity is the firm's sole criterion in making investment decisions. However, it is possible that either or both of these conditions do not hold for a firm.

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[1] The assumption is that the 15 percent cost of equity capital is the cost of funds obtained from the sale of stock. Taxes and flotation costs make the cost of retained earnings lower than the cost of new issues. See M.J. Gordon and L.I. Gould, "The Cost of Equity Capital with Personal Income Taxes and Flotation Costs", Journal of Finance (September 1978).

1. Equity Financing

For a project that is large in relation to the size of the firm, maintenance of a 40/60 debt/equity ratio requires that the equity funds be raised through a stock issue. If the company is not publicly traded, this would require that the company go public. Even if the company is publicly traded, a majority of the shares may be owned by one or a few persons. Hence, in either case a stock issue may be rejected by those presently in control of the company because they want to continue owning a majority of the shares.

If ownership of a minority of the outstanding shares is acceptable to the present stockholders, two problems remain. A 15 percent cost of capital for a stock issue may be true of a large widely held firm that undertakes an issue that is no more than 10 percent of the outstanding shares. However, when a small firm that is not well known to the investment community undertaken a large stock issue potential buyers may require a return of 25 percent or more. The 25 percent on equity translates into a WACC of 18 percent, and the present value of the above cash flows falls to $13.56 M, which is less than the $15M cost of the project.

The second problem posed by a project that is large in relation to the firm is its impact on the firm's total risk. Recall our previous classification of risk as systematic and unsystematic. Investors hold diversified portfolios of shares, since doing so eliminates from their portfolios the unsystematic or diversifiable risk of each share. A project's total risk may also be classified as systematic and unsystematic with the latter diversified away if the assets of the firm consist of a large number of projects. However, if the firm's assets include one large project, the firm's total risk includes a large fraction of the project's unsystematic risk. Stockholders in the firm that are portfolio investors and hold diversified portfolios diversify away the firm's unsystematic risk. However, the person or persons who have a controlling interest in a small

firm are likely to have that constitute practically their entire wealth. Hence, the firm's total risk is their total risk, and they will require a higher rate of return on the project than the WACC of 12 percent for a large widely traded firm.

2. Debt Financing

Debt financing can be either a complement to or a substitute to stock financing. Regardless, it is not freely available merely because the firm has a profitable investment project. A large firm with a conservative capital structure may be able to finance a project exclusively with debt, but that is impossible when the project is large relative to the firm's size. This is due to the nature of the debt contract. A loan with a 12 percent rate of interest will at most provide the lender with a 12 percent return, and as the probability of default increases the probability that the return will be less than 12 percent increases--in the limit the return can be - 100 percent. Hence, the expected rate of interest can be less than the nominal rate, and if the risk-free interest rate is 12 percent, the coupon rate must be raised above 12 percent as the loan's risk is increased in order to provide the lender with an expected rate of 12 percent. The coupon rate must be raised still further to provide a risk premium on the loan. The excess of the coupon rate of interest over the risk free rate that is needed to provide a satisfactory expected rate increases with the riskiness of the firm and with its debt to equity ratio.

However, this does not mean that a borrower can obtain credit merely by promising to pay a high enough interest rate. Financial institutions follow a policy of not extending credit where there is any material risk

of default in part because of concern for public image.[1] Hence, a firm willing to rely exclusively on debt to finance a project would not be able to obtain the credit, if the loan would be very risky--due to the size and risk of the investment project or due to an already high debt ratio. This credit rationing is imposed on all firms, but it is particularly acute for small firms. Not only are they subject to upper limits on their debt-equity ratios, but they can obtain no long-term credit unless it is used to finance assets that are considered adequate collateral.

A firm may impose on itself a lower limit on its debt-equity ratio than the limit imposed by financial institutions. A 40/60 debt/equity ratio may be optimal in the sense that it minimizes the corporation's cost of capital and maximizes the market value of its stock. This capital structure may make the stock quite risky, but that is of no concern to the portfolio investor, since he adjusts his portfolio's composition to a satisfactory risk level. However, the owner-manager of a small firm has practically all his wealth in the firm's stock and the risk of his portfolio is the risk of the firm's stock. To keep his risk within reasonable limits, the owner-manager may require a lower debt/equity ratio than a portfolio investor would require.

The management of a large widely-traded corporation may also impose a lower limit on the firm's debt/equity ratio than the limit imposed by financial institutions. The management does not have a diversified portfolio of jobs, and the costs to the management of bankruptcy or even a sharp reduction in earnings are much higher than the costs to shareholders. Management has other reasons for concern with the long run stability and survival of its firm!

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[1]Outstanding debt that is risky may sell at very high yields. However, new loans are made at interest rates which vary over a limited range. Hence, new loans are extended only if the probability of default is very small.

3. Alternative Sources of Private Financing

Inability or unwillingness to raise the equity and/or debt capital required to finance an economically profitable investment project does not mean that it will be abandoned. If the project is independent of the firm undertaking it, the owner will sell the project to a larger firm that is financially able to undertake it. Quite often, however, a project's cash flows are in part due to the knowledge, experience, and energy of the personnel in the firm that has the project, in which case the project is economically unattractive to other firms. This is particularly true of the investment opportunities that belong to small firms.

Some industries have been very innovative in developing financial arrangements for sharing a project's risk and return. This is particularly true of the oil industry. An exploratory well may have an expected rate of return of 25 percent, but this is the sum of a 95 percent chance of receiving nothing and a 5 per cent chance of a 2,400 percent return. Although such an investment would be attractive to a portfolio investor, a firm that consisted of two or three such wells would be practically certain to go broke. The oil industry has well established practices under which the investment and the payoff are widely distributed, with the expertise of the firm that found the oil prospect and the firm that will sink the well preserved by also giving those firms shares in the project. Notice that such sharing arrangements allow each firm to reduce its risk to a manageable level by participating in a large number of wells.

A common way in which a project that is financially unacceptable to a small firm is undertaken is through the acquisition of the firm by a large corporation. The expertise of the small firm's personnel including the owner is preserved through their continued employment, and the former owner is able to substitute a diversified portfolio for his company. The

company is most attractive to a larger firm in a related line of business, since the acquisition then provides the benefits of vertical or horizontal integration, and the larger firm has the knowledge needed to supplement and supervise the personnel of the acquired firm. However, the firm that find such acquisitions most attractive and are able to pay the highest prices, are typically U.S. or other foreign multinational corporations. In that case the long run growth potential of the small firm if not its entire operation is transferred abroad. The Foreign Investment Review Agency (F.I.R.A.) is intended to prevent this, but the agency is not always completely effective, and its role is primarily negative. That is in preventing a foreign acquisition which may not provide the Canadian economy with adequate benefits, F.I.R.A. does not at the same time find a superior domestic buyer. Perhaps F.I.R.A. should employ Wood Gundy type personnel to search for alternative domestic purchasers of a firm that is sought by a foreign corporation.

A less commonly employed method of financing a financially unattractive project is through venture capital firms. Typically, the venture capitalist provides the funds through a loan at the top end of the range of interest rates at which ordinary financial institutions lend, and the higher risk on the loan is compensated through the privilege of converting it into common stock or through options to buy the common stock of the firm. This arrangement suits the needs of the firm and of the venture capitalist in a number of ways. For the owner the needed funds are obtained, and at least for the early critical period of the firm's development control is maintained. The venture capitalist has no desire to participate in the firm's management as long as it is doing reasonably well, and if the firm gets into trouble that will be signalled by default on the debt, which will enable the venture capitalist to intervene. In most cases the venture

capitalist earns no more than the interest on the loan, but in those few cases where the firm is exceptionally successful, the venture capitalist shares in the exceptional appreciation through the conversion or option privileges of the loan. This will require that the firm go public, but the owner at that time is likely to also want a market for the firm's shares and a chance to diversify his portfolio.

Venture capitalist firms are in principal desirable vehicles for financing small risky firms with high growth potential. Their only drawback is that they may not provide an adequate supply of funds on reasonable terms.

4. Government Financing

The instruments of government intervention that are employed on projects which are economically unacceptable to the firm may also be employed for projects that are financially unacceptable. However, the purpose as well as the conditions under which the intervention takes place is different. On economically unacceptable projects the purpose is to increase fitability, although this may in part be accomplished by reducing the risk. On financially unacceptable projects the purpose is to reduce the risk, although this may in part be accomplished by increasing profitability. This difference makes the interpretation of each form of intervention somewhat different, and it also makes available forms of intervention that serve no useful purpose on economically unacceptable projects.

Before proceeding it will be useful to briefly review the cases under which financially unacceptable projects may arise and the government may consider it advisable to overcome the financial impediments. One case is the mega-project, such as the northern pipe lines and the tar sands plants, which tax

the financial resources of large publicly traded corporations. Another case is the existing firm that has experienced losses over a long period of time and faces bankruptcy. A Chrysler or a Massey-Ferguson may be economically profitable in that its value as a going concern is greater than its cost, the latter being what could be realized on the assets in liquidation, but the mass of debts make force the liquidation of the firm. The third and perhaps the most important and difficult case is the small firm that needs and should receive assistance in meeting its financing needs.

(a) Cash Grants and Operating Subsidies

A cash grant for the purpose of making a project financially acceptable need not be equal to the project's cost. The grant increases the firm's common equity and thereby increases the amount that the firm can borrow without reducing its debt to equity ratio. In addition, the grant increases a firm's willingness to assume a project's risk by making it even more profitable. Nonetheless, a grant is an inefficient means for making a project financially acceptable in that the cost to the government is likely to be much larger than the cost of other means for enabling a firm to finance a project. Furthermore, a cash grant is not only politically inexpedient in the present case, but it seems inappropriate to give a cash grant for a project that is already economically profitable.

Operating subsidies are even less appropriate than cash grants as means of overcoming financing problems. They provide no immediate funds to finance the project, and insofar as the operating subsidy is uncertain, it does not provide the equity base that can be used to obtain debt financing.

(b) Equity and Debt Capital

Equity capital would seem to be an attractive method of making it possible to finance a project for a number of reasons. The equity capital is not only a source of funds directly, but it is an indirect source through the debt capacity that it creates. In addition, the losses the government suffers on unsuccessful projects are covered more or less by the profits from the appreciation of the stock on successful projects. However, government ownership raises a number of problems that go far beyond the immediate goal of financing the project.

First and foremost, ownership gives the government the right to participate in decision making. Insofar as the government exercises that right, the decisions may not be as efficient as those made by private management solely concerned with profit. Perhaps more important, it creates a real or imaginary concern that the government will use its vast powers to favor the "government corporations" over private enterprise.

Another problem is that as an equity undesirable obligaions are placed on government, since there would be strong pressure from local employees and creditors for the government to assume unlimited liability in the event of serious financial distress. The argument would be that with the government as an equity owner, it would be believed that the full faith of the government lay behind the firm. In effect, this would create two classes of equity owners, the government and private owners. Although, this is not an acute problem for small equity participation by the government, it becomes important as the government's participation grows and/or the firm starts losing money. For the reasons stated above government ownership should be used as a financing device only where government ownership is desirable in its own right.

The extension of credit by government is a highly desirable method of making it possible to finance a project. If no equity capital is available, the loan can be equal to the full cost of the project. The loan can be made less than the cost of the project even though no equity capital is provided if the loan is made subordinated to other debt. A subordinated loan provides security to debt that has priority and thereby functions like equity capital.

Government loans, in particular subordinated loans, are very attractive from the viewpoint of political expediency since they can be made at prevailing interest rates and still serve their purpose, while appearing to involve no subsidy to the unsophisticated observer. In fact, a loan to finance a project that could not be financed privately involves a very substantial subsidy.

In theory the amount of the subsidy on a government loan may be calculated as follows. Assume that the interest rate on long-term debt to a financially sound corporation is 12 percent. Such a corporation would not take the trouble to fill out the documents required to obtain from the government a loan that could be obtained at the same interest rate from private sources. On the other hand, a corporation with $6M in common equity and $4M in debt may have an attractive investment opportunity that cost $15M, and the corporation may be unable or unwilling to raise the equity capital to maintain this capital structure. Assume that it would make the investment if the entire cost can be financed with debt at a 12 percent interest rate. No investment banker is willing to sell a $15M bond issue to the public under the above conditions, but a pension fund may be willing to lend the corporation $15M at a 20 percent rate of interest. A government loan at 12 percent carries a subsidy of $5.61M if the loan requires that the

interest be paid annually and the principal be paid at the end of 15 years.[1] This determination of the subsidy implicit in the loan is correct "in theory" and may not be correct in practice, only because it may not be possible to find the interest rate at which the firm could obtain the loan. The money may not be available commercially at any interest rate.

Can it be argued that the government loses nothing if it borrows at less than 12 percent and lends at 12 percent? The answer is yes if all the loans are repaid, but that is the rub. A substantial fraction of the loans extended under the above circumstances would not be repaid in full, and the logic of the 20 percent discount rate is that the lender would in fact earn 12 percent or at most 14 to 15 percent to compensate for the uncertainty as to what actually would be earned on such loans.

An alternative to government loans at prevailing interest rates is government guarantees on private loans. This course of action may be preferred because it takes advantage of the resources of commerical institutions in screening loan application and in administering the loan, or this alternative may be rejected because a government institution is considered more appropriate. The direct economic consequences of a 12 percent loan by government and a 12 percent loan by a financial institution with a government guarantee are identical.

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[1]The present value of the interest ($1.8M) and the principal ($15.0M) discounted at 20 percent is only $9.39M. A loan with the interest and principal payable in 15 equal annual payments would have a shorter duration and it would therefore carry a smaller subsidy. A periodic payment of $2.20M million for 15 years covers the principal and the interest at 12 percent on a $15M loan. If the $2.20M per year for 15 years are so risky as to require a 20 percent discount rate, they have a present value of $10.29M which implies s subsidy of $4.71 if the government pays $15M for this payment expectation.

(c) Venture Capitalist Route

We have seen that government loans or government loan guarantees contain a subsidy element, and as observed earlier it seems undesirable to subsidize investments that are economically profitable without the subsidy. It may be eliminated or substantially reduced by having the government behave like a venture capitalist. Loans that are convertible into common stock or carry the option to buy a stated number of common shares at a modest price enable the government to cover all or part of the losses on bad loans with the exceptional gains on the ventures that proved to be very successful.

This arrangement would not suffer from the disadvantages of having the government buy equity in the corporations at the outset. The government would not participate in the management prior to the date the conversion or the exercise of the option took place. If the loan were defaulted the government would behave in the same way as it would on an ordinary loan. If the company were successful and the government acquired shares in the company, they would be sold at their fair market value soon thereafter, either to the other owners of the company or on the market place. This provision would allay any fears that the program would be used by government to invade the private sector. There also need be no fears that the government would use its powers to make profitable the companies to which it extends credit, if as should be the case this type of loan program is confined to small businesses. The point is that if the government extended substantial credit to a Massey Ferguson, the government might use its power in a discriminatory way to make sure that the company survived, but no such fear would arise on a loan to a small business.

The case for government interest in financing small business is summarized by the adage "mighty oaks grow from little acorns." Similarly, great corporations and industries grow from the inspiration that gives rise to a small business, and society at large has an interest in minimizing the barriers to that transition. Unfortunately, a vast number of acorns are required to produce one sapling, and the probability any one sapling will grow into a mighty oak is quite small. Similarly, a large number of ventures are conceived each year, but only a small number of them take root and emerge as a small business. Most small businesses either fail or lead an indifferent existence, but it would be most unfortunate to have those which show exceptional promise to also languish or be transplanted to another country for lack of nourishment.

The problem is to identify and provide financial assistance to the promising small business enterprises without incurring the burden of extending high risk loans to a large number of worthless and even fradulent applicants.[1] To screen out undesirable applicants governments tend to make a mountain of paper work a condition for obtaining the loan, but such a screening process is most likely to turn away the enterprising vigorous frim that should receive the financial assistance.

The private venture capitalist is most likely to have the motive and the talent to carry out this screening function economically and effectively. The case against leaving the financing of small businesses with growth potential solely to venture capitalists is that the public interest may be served by more credit under more favorable terms than would be available from venture capitalists. That is, their screening would not be incorrectly

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[1] A Company is formed with a capital of $100,000 and it borrows $5M to invest in a long shot. The owners win if the horse comes in and the government loses if it does not. Better still, Mr. X forms companies Y and Z. Z borrows $5M to buy for $5M an asset from Y that cost Y only $1M. Z defaults on the loan and Mr. X lives happily ever after on the $4M profit made by Y. Other variations on this moral hazard problem are discussed below.

applied but it would be too stringent. The solution is to stimulate the venture capitalist function by programs which attract capital and various financial institutions to the industry. This has been done more or less successfully in both the U.S. and Canada, and a review of this experience could determine whether existing programs are adequate.

5. Avoidance of Bankruptcy

The current predicament of Chrysler and Massey-Ferguson make very topical the problem of bankruptcy--when it should be avoided and the most effective methods for doing so. The economic and legal definitions of bankruptcy are different and extremely complex. Moreover, neither adequately describes what takes place when a firm enters a period of financial difficulties. According to the economist a firm is bankrupt when the value of its assets falls below the value of its debts. According to the law a firm is bankrupt when a firm is unable to meet its debt obligations. In fact a firm is bankrupt only when bankruptcy has been declared and liquidation ordered.

The problem with the economic definition of bankruptcy is that the value of a firm in financial distress is a matter of considerable dispute. Stockholders claim that the value of the assets exceeds the value of the debts to the very last, and they point to the value of the stock which remains positive until liquidation has taken place. The problem with the legal definition is that firms with their debt in default continue operating, either because the creditors do not press their claims or because a court appointed receiver comes between the firm and the creditors.

Let us start our analysis with the first step on the long path that may or may not lead to bankruptcy. A firm is unable to meet its debt obligations due to some combination of losses over a period of years and a

previously high debt ratio. The going concern value of the firm's assets may or may not exceed their liquidation value. In the latter case the firm would be liquidated even if it had no outstanding debt. Furthermore, it should be kept in mind that market value is a weighted average of possible future values. For instance, if Massey-Ferguson's going concern value is less than its liquidation value now, a combination of fortunate events that are within the bounds of reason may restore highly successful operations in a few years. Conversely, the reverse is also true. If the goind concern value exceeds the liquidation value now, bad luck and bad management may bring the firm down in a few years time.

Assume that the going concern value exceeds the liquidation value. If the firm had no outstanding debts it would continue operating, while these debts may force liquidation and a loss to everyone concerned--including the employees and society at large. The ideal solution is a voluntary financial reorganization which converts the debt into preferred stock and/or common stock and which converts the preferred into common stock. Voluntary financial reorganizations are extremely difficult to carry out, because they require the agreement among a large number of independent parties, each of which is embittered by the past and believes that the burden of the reorganization should fall more heavily on the other parties.

An alternative course of action is a financial reorganization imposed by the receiver in bankruptcy. However, this depends upon the bankruptcy law. The law may favor the "absolute priorty" rule or the "relative priority" rule.[1] The former limits the authority of the receiver to liquidating the firm and distributing the proceeds to the claimants in the order specified by their legal claims. The relative priority rule allows the receiver

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[1] See Arthur S. Dewing, Financial Policy of Corporations, Ronald Press, N.Y., 1941, pp. 1227-1470.

to impose a financial reorganization on the security holders with the consent of a majority or a larger percent of each class of security holders. The reorganization allows the firm to continue operating by converting all or much of the debt into securities which have no fixed claims on the corporations.

Bankruptcy law in Canada appears to conform to the absolute priority rule, and it is of little value in facilitating involuntary reorganizations. This is unfortunate and there is some consideration being given to the revision of the law.

The third way in which the financial reorganization of a firm with a going concern value in excess of its liquidation value may take place is through a government subsidy that induces the security holders in the corporation to accept the plan. The government may be persuaded to contribute towards the reorganization plan by the employment and other social benefits of the firm's continued operation. Before taking up how this contribution should be structured it should be pointed out that the government may find it advisable to contribute towards keeping the firm going even if the going concern value is less than the liquidation value.

The government interest in continued operation of the firm may be clarified as follows. Assume a firm with a liquidation value of $25M. Assume also that if it is kept alive for three more years it will then have a value of $500M or a value of -$300M. each with some probability. Both figures include the near certain negative cash flow over the next three years, with the -$300M assuming liquidation. The probabilities assigned to each of these outcomes and the discount rates that are correctly applied to them may result in a present value of $74M, which is greater than the liquidation value. On the other hand, different probabilities and discount rates might result in a going concern value now of -$50M which is $75M below the present liquidation value.

The above numbers, however, consider only the costs and benefits to security holders. Continued operation for 3 years benefits the employees and government, and if good luck and good management prevail, the continued operation and growth of the firm thereafter may convey immense benefits to employees and government. Hence, it may be a sound decision of government to provide the financial support needed to keep the firm afloat.

A Massey-Ferguson or a Chrysler needs two things: (1) a financial reorganization; and (2) new funds to make the investments needed to restore its fortunes. The role of government is clear. It should provide additional funds in some way, and make as a condition for the new funds that a sweeping and fair financial reorganization takes place. The new funds may be provided through a loan, the purchase of stock or a loan guarantee. Since these funds greatly increase the private value of the corporation it can be used to persuade the creditors to accept common stock in exchange for their debt, and to persuade the present stockholders to accept a drastic reduction in their equity in the company. The alternative that the debt holders face is a few cents on the dollar and the alternative the stockholders face is complete elimination.

The authors have not examined the Massey-Ferguson reorganization in detail. However, our impression from newspaper accounts is that it did not follow the above principles. Rather, it appears that both the common stockholders and the government gave more than they should have and most of the creditors gave far less than was equitable and needed for a sound reorganization. The government made a very large contribution through its loan guarantees, and the common shareholders gave up practically the entire common equity, while the creditors received most of the common equity in exchange for just the interest in arrears on the debt. The debt remains in place so

that the problem recently solved will reappear one year hence and periodically thereafter until the firm is liquidated or a dramatic improvement in its fortunes takes place. In short, the creditors are in a position to continue using the threat of bankruptcy to force continuing financial support from government.

VIII. EMPLOYMENT LEVEL AND STABILITY

Governments provide investment incentives to achieve various social objectives, among which a high and stable level of employment has the highest priority. In this section we examine how the structuring of a government incentive program can affect this social objective of a high and stable level of employment. Principally, we will discuss two effects. The first is the inevitable decision of the firm, where possible, to choose an investment technology that minimizes cash flow fluctuation and the size of the capital investment. We will see that the corollary of this decision is a relatively high but variable level of employment. The second effect is what is called the moral hazard problem, by which we mean that a government subsidy may create an incentive for the firm to change its behavior so as to defeat the purpose of the subsidy. We will see that providing a cash grant or low cost loan with 'no strings attached' creates a severe moral hazard problem, whenever this financing becomes a sizeable proportion of the total investment cost. This can also have employment implications.

1. Employment Benefits and the Choice of Technology

We have seen that if the expected rate of return is less than the cost of capital, to undertake a project would destroy some of the value of the funds raised to finance the project. Hence, the project requires a wealth transfer from the government to offset this private loss of wealth. This wealth transfer can be accomplished in a variety of ways. However, the implications for the continuity of the social benefits associated with the

wealth transfer are not the same for each financing option. In particular, if we assume that the wealth transfer is required to expand production in a rural, high unemployment area, we must ask how we can maximize the employment benefits per dollar of subsidy granted, and how we can maintain the employment benefits after the capital investment is made and the project is underway.

Maximizing the employment per dollar of subsidy granted is an easy task. The menu of projects presented to the government for subsidization will result in plants with different labour-capital ratios, and the subsidy a firm requires to undertake a proposed investment is likely to be more or less proportionate to the project's cost. Hence, by selecting projects with high labour-capital ratios the government can maximize the employment per dollar of subsidy. We will see shortly, however, that the instability of employment is likely to increase with the labour-capital ratio, and it is not clear what the government's objective should be.

The government may also influence the labour-capital ratio incorporated in the design of any particular plant. A firm adopts the plant technology that maximizes the excess of the present value of the projects future cash flows over its cost. The government subsidy changes the cost or the value, and by making the subsidy depend on the type of plant built, the government can influence the technology and labour-capital ratio of the plant.

It is instructive to consider how the firm goes about adopting a plant technology in the absence of a subsidy or when the subsidy is independent of the technology adopted. To the firm labour is often taken to be a variable factor of production, in that if the economy and demand for the firm's product weakens, the firm can lay off some of its labour force and reduce its variable costs. Thus, any shortfall in revenues is offset by a reduction in

variable costs, making the firm's cash flow stream less volatile then it would otherwise have been. From the firm's perspective the more labour employed, the less sensitive its projected cash flow stream is to economic uncertainty. This allows the firm to incur more debt financing and increase the expected rate of return to its common stockholders. Hence, other things being equal the firm will tend to use a higher labour-capital ratio to reduce the riskiness of its expected cash flow stream. This tendency is of course mitigated by the technology available to the firm, in that very often the firm has no flexibility in choosing a plant that requires a higher proportion of labour to capital at capacity operation.

The government on the other hand has a completely opposite point of view. In a period of economic depression, the firm's laying off of workers contributes to its economic problem, since these laid off workers will represent a further drain on the government's resources. Hence, while the firm sees a high proportion of labour as lowering the risk of the project, the government instead sees the possibility that although overall employment is increased it is also more variable.

2. Illustration of the Problem

The variability in employment problem may be illustrated as follows. Suppose for example a $10M project had the following expected income statements under two different production technologies,

	A	$M	B
Revenues	15		15
Materials	4		4
Labour	3		6
Headquarters Expense	2		2
Depreciation	4		1
EBIT	2		2

Under both production technologies the firm expects earnings before interest and tax to be $2.0M, resulting from the sale of one million units of output at $15 each. With production technology A the firm has 150 men employed at $20,000 per man and four units of machinery with annual fixed costs of $1M each. With production technology B the firm employes 300 men at $20,000 per man and 1 unit of machinery at an annual fixed fixed cost of $1M.

On the basis of expected profitability the firm is indifferent between the two production choices. However, the 150 men at $20,000 per man translates into a variable labour cost of $3 per unit for production technology A versus $6 for production technology B. Hence, if demand decreased to 0.6M units or increased to 1.4M units we would have the following expected income statements.

	A		B	
Unit sales	0.6	1.4	0.6	1.4
Revenues	9.0	21.0	9.0	21.0
Material cost	2.4	5.6	2.4	5.6
Labour cost	1.8	4.2	3.6	8.4
Headquarter's cost	2.0	2.0	2.0	2.0
Depreciation	4.0	4.0	1.0	1.0
EBIT	(1.2)	5.2	0.0	4.0
Labour employed	90	210	180	420

Since the expected earnings before interest and tax are less variable with production technology B, this would be the chosen production technology.

The above example illustrates the basic idea of 'operating leverage' That is with higher fixed capital costs and lower variable costs the firm has a higher break-even point, which results in more variable profits as demand varies.[1] All other things held constant, the firm will choose the

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[1]The break-even analysis and operating leverage idea is discussed in any basic finance text, for example see J.F. Weston and E. Brigham, Managerial Finance (6th ed.) Dryden Press, 1978.

production technology with a higher labour-capital ratio, that is lower operating leverage. This is because the ability to lay off labour moderates the demand fluctuation faced by the firm. Thus profits and cash flow are not as variable as under the higher operating leverage option.

In Figure VIII-1 we graph the ideas expressed in the above example. Technology A has the net profit line $A\pi$, which shows that the break-even point is 750,000 units. Technology B has the net profit line $B\pi$, with a break-even point of 600,000 units. If demand fluctuates between 800,000 units and 1,200,000 units, the profit fluctuation under technology A is π_A and under technology B is π_B. Since the profit fluctuais greatest under technology A, technology B would be chosen. In the lower half of figure 1 is the employment-output decision showing how the variable labour force varies with the firm's output decision. With technology A, the labour force fluctuates by L_A as output fluctuates between 800,000 units and 1,200,000 units. With technology B the labour force fluctuates by L_B with the same output fluctuation. Note that the corrolary of minimizing profit fluctuation is maximizing labour force fluctuation. Hence, the choice of B causes minimum profit fluctuation π_B and maximum labour force fluctuation L_B.

The above example is somewhat stylized, in its assumption on how inputs and cost vary with output. However, there is considerable empirical evidence[1] that the cost functions are of the simple linear form assumed here, that is they have a fixed cost term and an amount that is proportionate to output. A further implication of this analysis, is that the choice of technology B with the higher labour-capital ratio also reduces the machine requirement to one unit from 4 units. Hence, the amount of capital required

[1] See A. Walters, "Production and Cost Functions: An Econometric Survey, Econometrica, (January 1963).

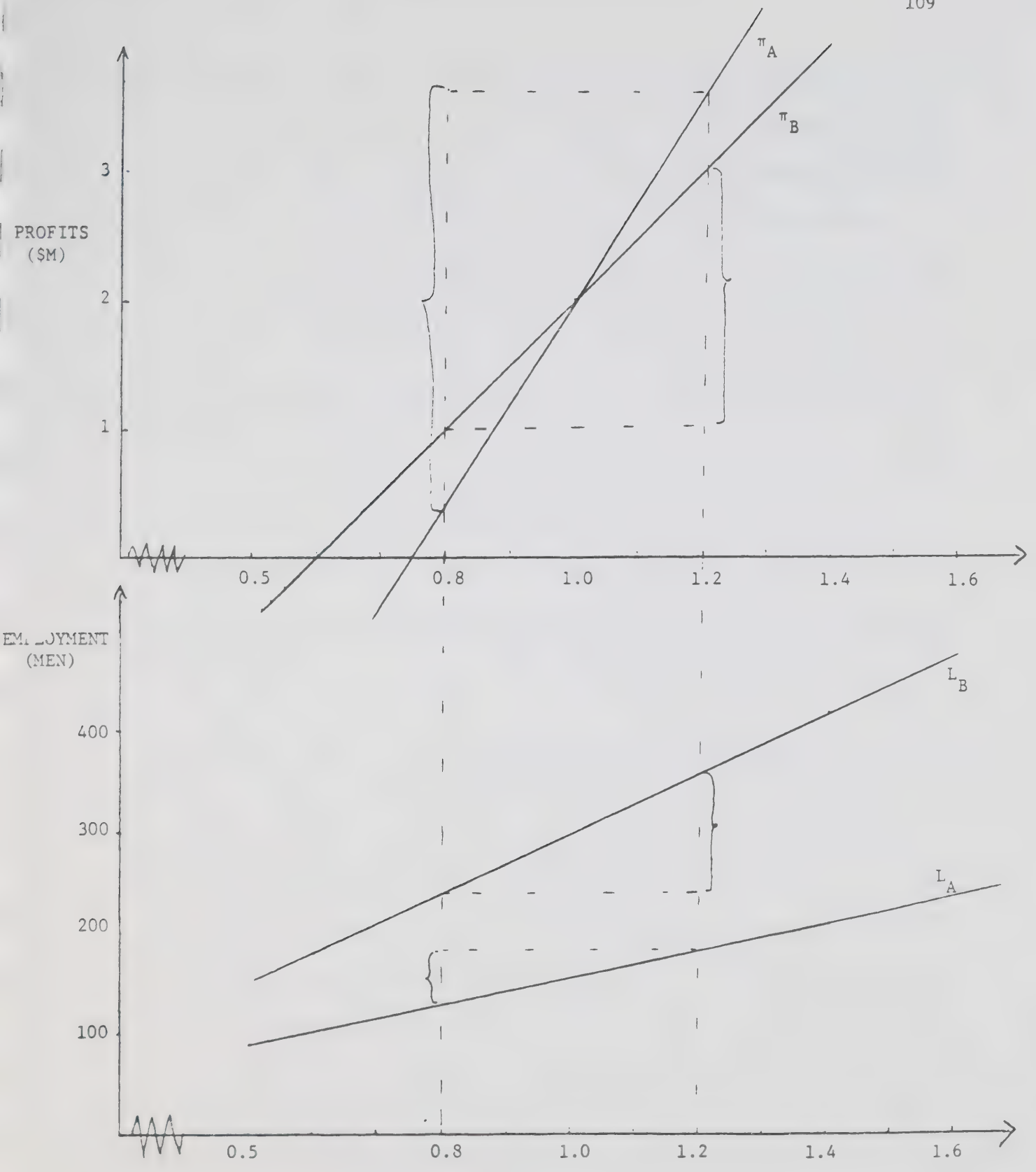

FIGURE VIII-1

to undertake production and meet market demand is reduced. The result is not only reduced profit fluctuation, but also reduced capital requirements, so less investment is actually at risk.

The implication of this line of reasoning is that if the firm believes that the project is too risky and would not invest in it without an incentive, after the government provides an incentive, the firm will tend to chose a higher labour-capital ratio. This reduces the capital at risk and reduces profit fluctuation. This is a classic risk reduction strategy that is often adopted by companies operating in the Third World. Fearing expropriation the firm invests in 'low technology' production, which almost always entails high labour-capital ratios, which reduces the capital at risk and the profit fluctuation. The problem for the government is its reaction to an employment result, that while increasing overall employment may also make that level of employment highly variable.

3. Government Policy to Influence Employment

We have seen that the government faces a choice between the level and stability of employment in selecting among projects. However, the previous illustration was over simplified in that it ignored the dependence of price and the level of output on the technology of the plant, and it thereby understated the extent to which employment variability rises with the labour-capital ratio. After examining this dependency and its implications, the ways in which a subsidy program may be structured to increase the stability of employment will be investigated.

In the previous section it was assumed that as industry demand fluctuated the product's price remained unchanged, and if the sales of a high technology plant rose, say 30 percent the sales of a low technology plant

also rose 30 percent. Let us take a more realistic look at what happens. As industry demand falls firms will tend to shave the prices they charge below the listed price, and as this shaving increases, the listed price falls. Conversely, as industry demand rises actual prices move closer to listed prices, and the latter rise. In addition, when demand is strong and the price is high in relation to operating costs, all plants operate at or close to capacity, but as demand and price fall, output is maintained close to capacity in the efficient plants and the marginal plants are shut down.

Which firms or plants shave prices and maintain output as industry demand falls and which plants are marginal and are shut down? The marginal plant is the one with a high variable cost per unit of output, and the firm with high variable cost per unit of output is more reluctant to shave prices and maintain output. In our previous illustration, plant A with a low labour-capital ratio has variable production cost of $7.00 per unit while plant B has variable production cost of $10.00 per unit. The firm with plant A is in a better position to cut prices in order to maintain sales, and it will not shut down as long as price remains above $7.00 per unit (assuming that headquarters expense as well as depreciation is completely fixed), while plant B will be shut down when price falls below $10.00 per unit.

The shut down of a plant may be temporary or permanent. The former takes places when price falls below variable production cost. The permanent shut down takes place when the long run expected future price falls below variable production cost plus avoidable headquarters expense.

The decision whether or not to abandon a plant permanently is influenced by how the subsidy is arranged. The worst type of arrangement is a loan to a legally independent subsidiary that is created to own and operate the subsidized plant. In that case the abandonment of the plant relieves the parent company of the loan obligation, and in that case abandonment takes place when the long-run expected price falls below total cost including depreciation and a fair return on capital. The latter are assumed to be equal to the amortization of the principal and the interest on a loan equal to the plant's cost. Note that when the loan is to the subsidiary, abandoning it eliminates the cost, whereas when the loan is to the parent, the interest and principal must be paid regardless of what is done with the plant.

The earlier discussion of how the price and production policy of a firm depends on the efficiency of a plant makes clear the considerable danger in subsidizing a plant with a high labour-capital ratio. Such plants are marginal, their employment fluctuates very highly and they are shut down first when demand falls. We now consider how a subsidy may be structured to stabilize employment when the plant design is fixed and will not be influenced by the subsidy policy.

When the subsidy takes the form of a cash grant or a low-cost loan, the subsidy only secures the building of the plant and it has no influence on the subsequent employment in the plant. It is determined by the product prices and operating costs in each year of operations as described above. Consider now an annual subsidy that is fixed regardless of the level of operations. If it has the same present value as the grant, a firm with no financing problem is indifferent between the two, and its subsequent operations once the plant is built remain independent of the grant. On

the other hand a subsidy that is proportional to the employment in the plant--say 20¢ per hour of production employment--reduces labour cost correspondingly, and it has the same effect as a reduction in the labour-capital ratio. Consequently, the variability in employment is reduced.

To elaborate, it might seem that the employment subsidy is counter-productive in that it gives a firm a large subsidy when employment is high and there is no need to encourage employment, and the subsidy is low when the opposite is true. In fact, we have seen that when industry demand is strong all plants operate at or close to capacity, and the subsidy would not further increase employment. However, when demand is weak, the extent to which price is cut and output is maintained (and the plant is not shut down) depends on how low is the variable cost of production. The wage subsidy therefore tends to maintain employment when it is needed most.

What the above suggests is that the ideal employment benefits are obtained when the subsidy per hour worked is made to vary inversely with the industry level of employment. A high subsidy when plant employment is low would encourage the reduction of employment in the plant when employment is generally low. However, a large subsidy per hour worked when industry employment is low would further increase the competitive advantage of a plant during a period of depression.

There also is an important financial advantage to such a variable subsidy program. The amount of the subsidy per hour worked would have to be set so that the expected future cash flows to the firm from the subsidy when discounted at a rate appropriate to their risk would have a present value equal to the excess of the project's cost over its present value without the subsidy. Consider now the risk implications of a subsidy per

hour worked that varies inversely with the level of employment. The cash flows would be high when business conditions are bad and vice versa. The subsidy benefits would be like an asset with a negative beta and the cash flows would be discounted at a rate that is below the interest rate. The dollar cost in total of a variable subsidy would therefore be less than the dollar cost of fixed subsidy per year or a fixed subsidy per hour worked, and the employment benefits would be greater.

Employment subsidy programs, however, pose three problems. One is the greater administrative burden posed by an annual subsidy related to the level of employment by comparison with a single benefit that is fixed at the outset. Secondly, the legislative arrangements needed to guarantee the subsidy as promised over the life of the plant may be difficult. To the extent that firm is afraid that the program will be terminated it will find the benefit more risky and less valuable. Thirdly, such a subsidy would increase the instability of employment elsewhere in the industry, and it would be opposed on that account by other firms and workers in the industry.

4. Moral Hazard Problem

The classic example of a contract that poses the moral hazard problem is insurance. Assume that with the care and preventive expenditures that would be undertaken by an uninsured person, the average annual loss of residential property due to fires is $25 per $1,000 of property. With insurance the average loss would be larger, because a person relieved of the loss would reduce the expenditure of time and money to prevent fires. Hence, when the difference between insured and uninsured behavior is small, as with the prevention of death, insurance takes place, but when the difference is large insurance is not economically feasible.

The moral hazard problem also arises with a loan that is a large fraction of a firm's net worth. For example, consider the two projects A and B with the following equally likely payoffs,

Project	Cost	State	Payoff	Probability
A	$10M	I	$13M	0.5
		II	$9M	0.5
B	$8M	I	$11.6M	0.5
		II	$4M	0.5

If the firm undertakes project A then there is a 50% chance of receiving $13M and a 50% chance of receiving $9M, for an expected receipt of $11M. For a $10M cost this represents a 10% expected rate of return. All in all, this is a marginal project. However, Project B offers only an expected receipt of $7.8M for a cost of $8M and an expected return of -2.5%. If the two projects were mutually exclusive, the firm would only choose project A. However, if the firm's cost of capital exceeded this 10% expected rate of return, even this project would not be acceptable.

If the government now offered the firm a $6M loan at an interest cost of 5% the investment payoffs now become,

Project	State	Payoff	Debt	Equity	Payoff Probability
A	I	$13M	$6.3M	$6.7M	0.5
	II	$9M	$6.3M	$2.7M	0.5
B	I	$11.6M	$6.3M	$5.3M	0.5
	II	$4M	$4M	0	0.5

For project A the firm can afford to carry' the 5% debt, since regardless of which state occurs the firm can payoff the debt in full. The result is that the expected equity receipt is now reduced to $4.7M. However, now that $6M is provided by the government, only $4M needs to be contributed by the equity owners. Hence, the expected rate of return on the equity increases to 17.5%. With this expected return and the low cost government debt, the project may now be privately acceptable and thus undertaken.

However, we must also consider project B, which was previously rejected. If the firm now accepts project B after it has received the $6M loan from the government to finance project A, we see that in State I the firm pays off the loan and the equityholders receive $5.3M. In state II, the cash flows from the project cannot repay the loan to the government. Hence, the firm walks away from the project, leaving the government to take it over to at least obtain partial repayment of its loan. Although, the equityholders receive nothing in state II, their expected receipt is $2.65M, which for a $2M investment now offers a 32.5% expected rate of return. Even though project B is riskier to the equityholders, the higher expected rate of return to them may cause them to elect project B over A.

This reversal of choice is an example of risk-shifting, which is one aspect of the moral hazard problem. Project B is clearly unprofitable, it offers a negative expected rate of return and has more variable payoffs than project A. However, when the government offers a $6M loan it changes the profitability of the project to the equity owners. Although, the payoffs are now even more variable, it now has a superior expected rate of return. If the government could be induced to lend $7M at 5%, the expected rate of return would increase still further to 112.5%. This illustrates the second implication, that as the proportion of debt financing increases, the attractiveness of these highly uncertain investments increases.

Essentially, in risk-shifting the equityholders change the firm's investment and force the debtholders to bear some of the risk. With project A there was no risk to the debtholders, since the debt could be repaid in either state of nature. However, with project B in state II the debtholders only receive $4M; their expected payment is reduced to $5.15M for an expected

rate of return of -14.16%. The expected rate of return on project B thus changes from -2.5% to the equityholders, to 32.5% and -14.16% to the equity-holders and debtholders respectively. By changing the investment choice the firm's equity holders shift some of the risk onto the debt holders and gain at their expense.

In the employment example cited earlier we had a variant of this moral hazard problem, in that after a low cost loan was forthcoming a firm might then decide to opt for the high labour-capital ratio choice. This served to reduce future cash flow fluctuation and reduce the initial equity investment. Although, this is not identical to the risk shifting just described, since the value of the low cost debt is not reduced, there is risk shifting ocurring. In this case, risk shifting occurs from equityholders to society at large as a result of the increased employment variability. In both cases, after the government low cost debt or cash grant is provided, the firm's investment behaviour is changed, either to increase the expected return to equityholders or reduce the risk to them.

This pattern of risk shifting is pervasive in small firms where it is very difficult to ensure that the stated objectives of the loan are actually carried out. Hence, the difficulty in raising funds at reasonable rates for small businesses. Either strict monitoring of the firm's performance is required or investors require a substantial 'piece of the action'. Both solutions act as a deterrant to the innovative firm with a need for funds Continual supervision of managerial policies hampers good management and considerable dilution of the reward for innovation acts as a deterrant to innovative activity.

A partial solution to these problems is provided by the convertible security. Suppose for example that the government provides the firm with

$6M in debt at a 3.83% interest cost with the debt convertible into common stock. Suppose that the debt is convertible into 81.6% of the proportion of the firm that the debt finances.[1] The payoffs from the two projects now become,

Project	State	Payoff	Debt	Equity	Probability
A	I	$13M	6.37	6.63	0.5
	II	$9M	$6.23	$2.77	0.5
B	I	$11.6M	$7.1M	4.5	0.5
	II	$4M	$4	0	0.5

With project A the government will convert in state I and claim 49% of the firm (.816*0.6) to receive $6.37M. In state II the government will not convert, but instead receive the contractual interest and principal repayments of $6.3M. The stockholder's expected return is constant at 17.5%. However, with project B in state I the government now benefits from the extremely high payoff to receive 61.25% of $11.6M or $7.1M. In state II it still only receives the distress proceeds of $4M. However, overall it expects to receive $5.55M for a return of -7.5%. The equityholders expect to receive $2.25M for a return of 12.5%.

The virtue of the convertible is that it allows the government to participate in the 'ill gotten' moral hazard proceeds. Although, the expected return is still negative for the government bond holder, if project B is selected, it sufficiently improves to make project B less attractive to the equity holders than project A. Hence, it partly corrects for the moral hazard problem that encourages the firm to switch investment projects after the government decides to finance the project.

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[1]This complicated conversion formula is used to motivate the example. In practice, an expected stock price determines the conversion ratio. However, such a modification would considerably complicate the example.

However, the convertible does not completely solve the moral hazard problem. In the previous example, the convertible reduced the profitability of switching to project B by diluting the equityholder's claim to the rewards for changing investment strategy. Hence, it curbs the rewards to risk-taking. The problem is that the dilution required to negate the effects of project B also can tend to reduce the profitability of project A. Hence, the terms of the convertible have to be very carefully drawn up. Secondly, the convertible may be perfectly acceptable ex ante, but after the event it may engender animosity. For example, suppose the firm still went with project B and state I occurred. In this case, the government by converting the bond will have profited by the change from project A to project B and will considerably dilute the ownership of the original equityholders. This would obviously leave the government open to charges of exploiting the original equity owners by acting monopolistically and charging extremely onerous terms, especially since the government would then end up with control of the firm.

Despite these difficulties the convertible feature has the key advantage of allowing low cost financing during the initial start up period of unprofitability, that nearly all firms encounter. Moreover, when the 'winners' emerge the government will then convert its debt into equity and participate in the increased value of the winners. From a social point of view the moral hazard problem is reduced, low cost financing is provided during the crucial early years and yet the government receives a return on its investment. The size of the incentive required will determine the initial interest cost of the convertible and the convertibility feature. For example, to provide more incentive the convertible discussed previously

could have a 0% interest rate and be converted into 50% of the ratio of initial funds contributed.

A final additional advantage is that the government can always structure its investment as a convertible preferred issue. This has the additional advantage of allowing the preferred to be classified as stockholder's equity and not as debt. Hence, the convertible preferred will not impair the firm's ability to issue senior secured fixed interest debt raised from private lenders. The final problem of increased government control through equity participation can always be removed by an agreement in the terms of the convertible preferred issue that the government on conversion sell the shares of common stock to private investors.

5. Conclusions

In Table VIII-1 we summarize our conclusions for the main methods of providing incentives. We evaluate the financing alternatives on the two criteria discussed in this section, the continuity of employment benefits and the tendency to prevent risk shifting. All outright cash grants, loan guarantees and preferred stock or debt financing options without strings attached are deficient in that they provide the government with no leverage to ensure continuation of the project and no disincentive to change technology or shift risk. The low interest loan can have interest payments tied to employment as can the operating subsidy. Hence, both alternatives can apply pressure to continue the level of employment. However, there is little disincentive to shift risk, although this is a minor problem with the operating subsidy. The common equity and convertible preferred or debt both provide leverage to maintain commitment to the project either through a vote or the reduction of interest or preferred stock dividend incentive. However, the common equity does not prevent risk shifting in the same way that the convertible

preferred does, since the common equity alternative merely allows more private debt to be issued and the government then participates with the private equityholders in any risk shifting. The convertible feature however is a deterent to this risk shifting behaviour. Hence, the conclusion of this section is that the low dividend convertible preferred share has most of the advantages required of a vehicle for government financial subsidies.

TABLE VIII-1

Consequences of Possible Government Incentives

	Employment Continuity	Risk Shifting
Cash Subsidy	+	+/-
Low Interest Loan	+	-
Cash Grant	-	-
Loan Guarantee	-	-
Preferred Equity	-	-
Common Equity	+/-	+/-
Low Interest Convertible Preferred or Debt	+	+